Technical Overview of the 4pi Calibration System

The 4pi Group

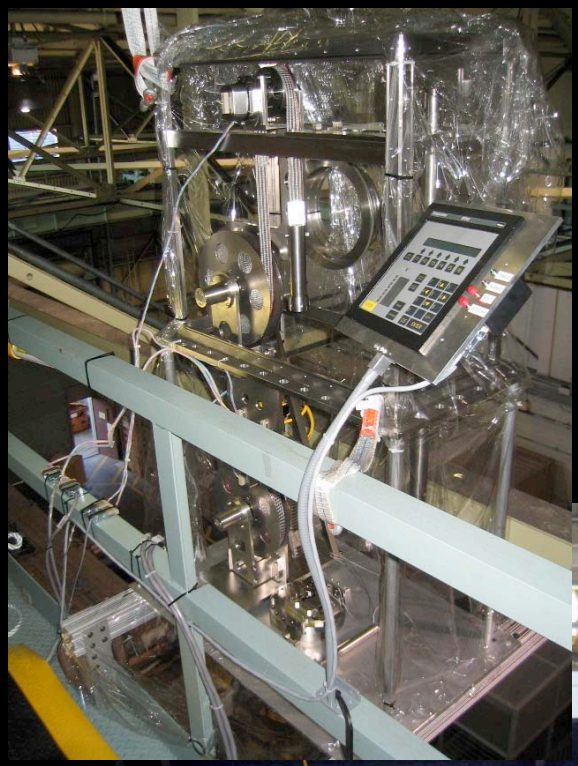
4π Group

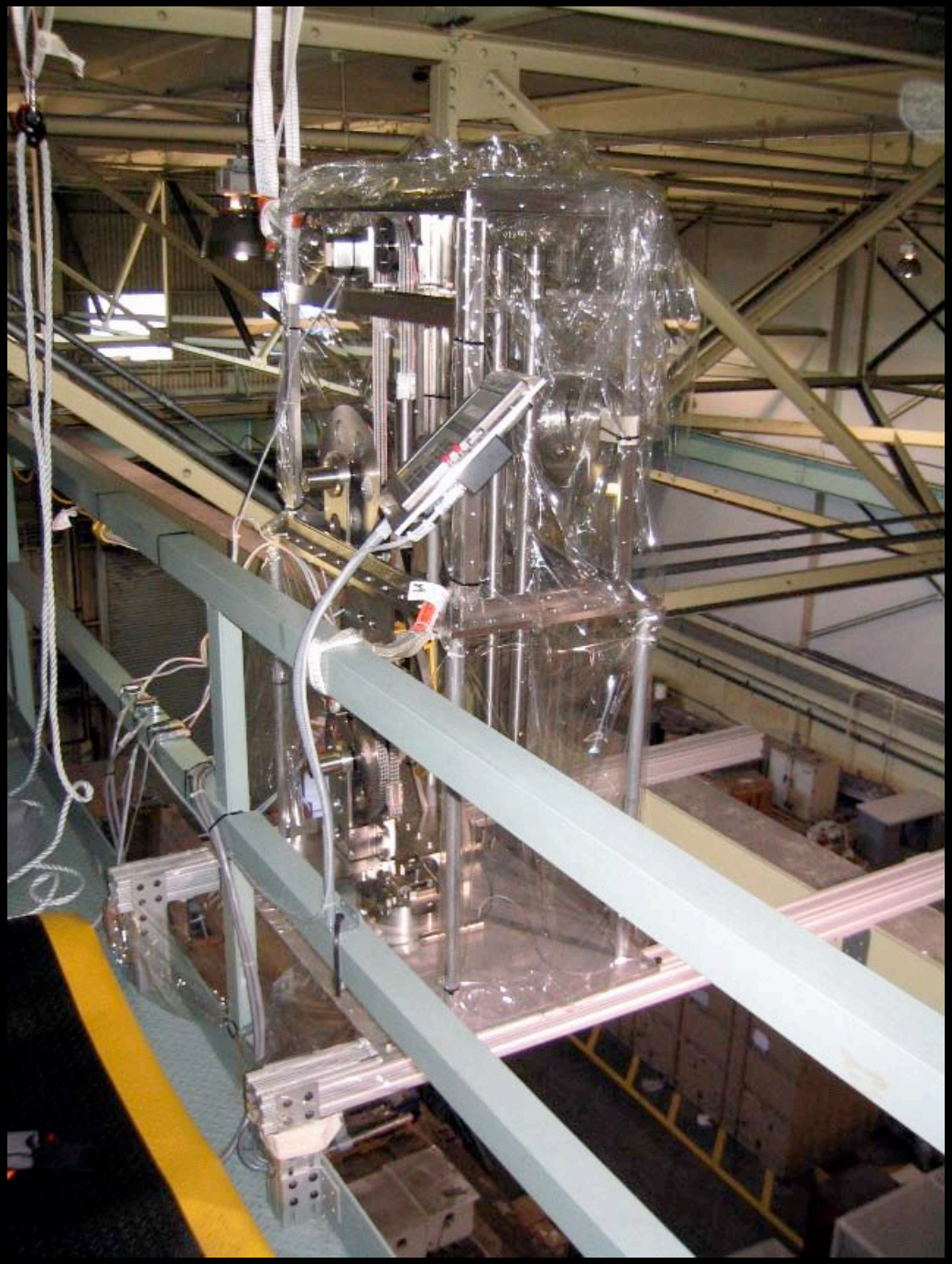
S. Abbott
B. Berger
T. Classen
P. Decowski
D. Dwyer
A. Franck
S.J. Freedman
B. Fujikawa
M. Galloway
F. Gray
K.M. Heeger
J. Meyer
J. Learned
K.-B. Luk
Y. Minamihara
B. Perry
M. Rosen
H. Steiner
D. Syversryd
E. Yakoushev
T. Walker
J. Wallig
L. Winslow

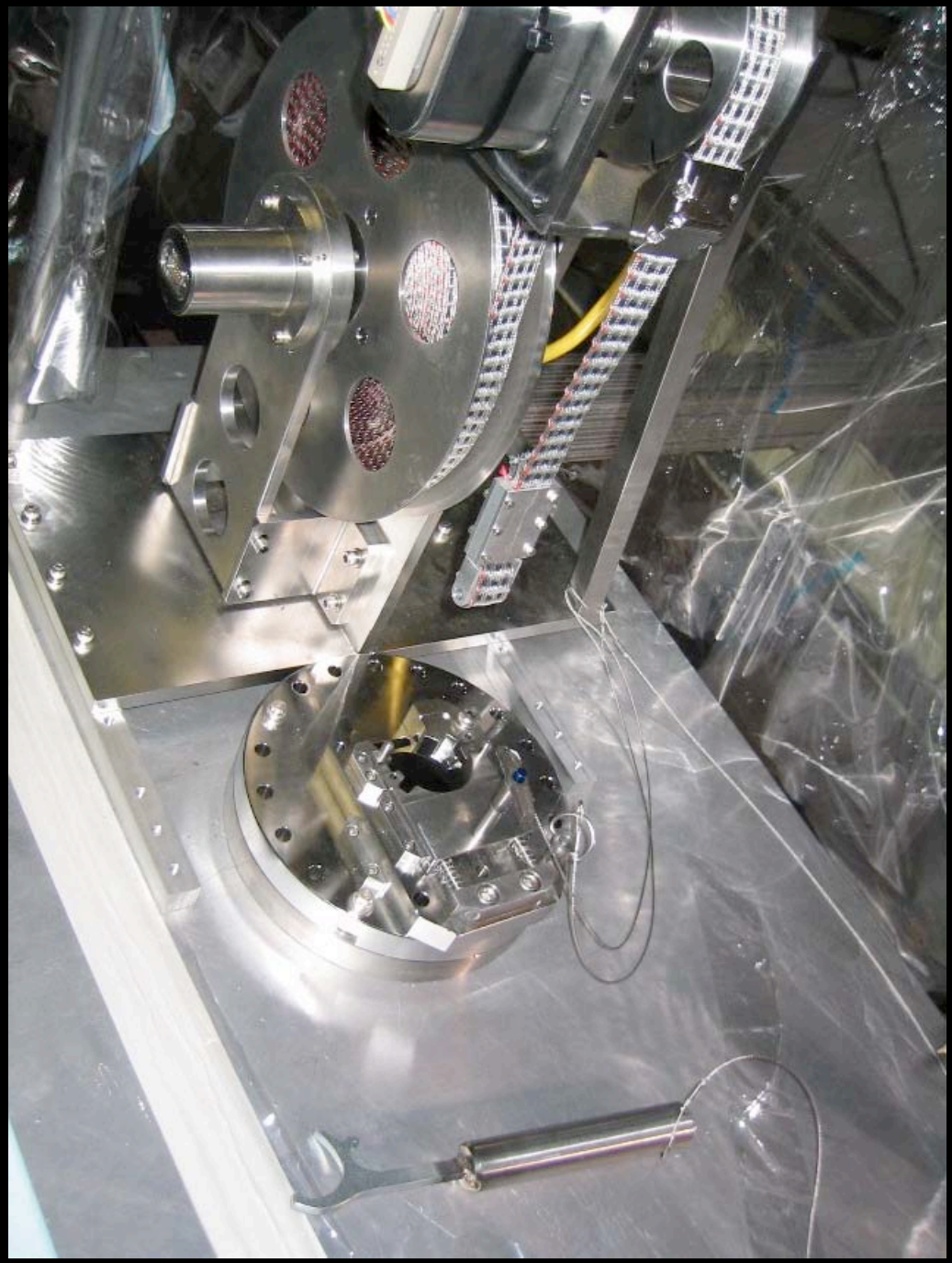
http://kmheeger.lbl.gov/kamland/4pi/

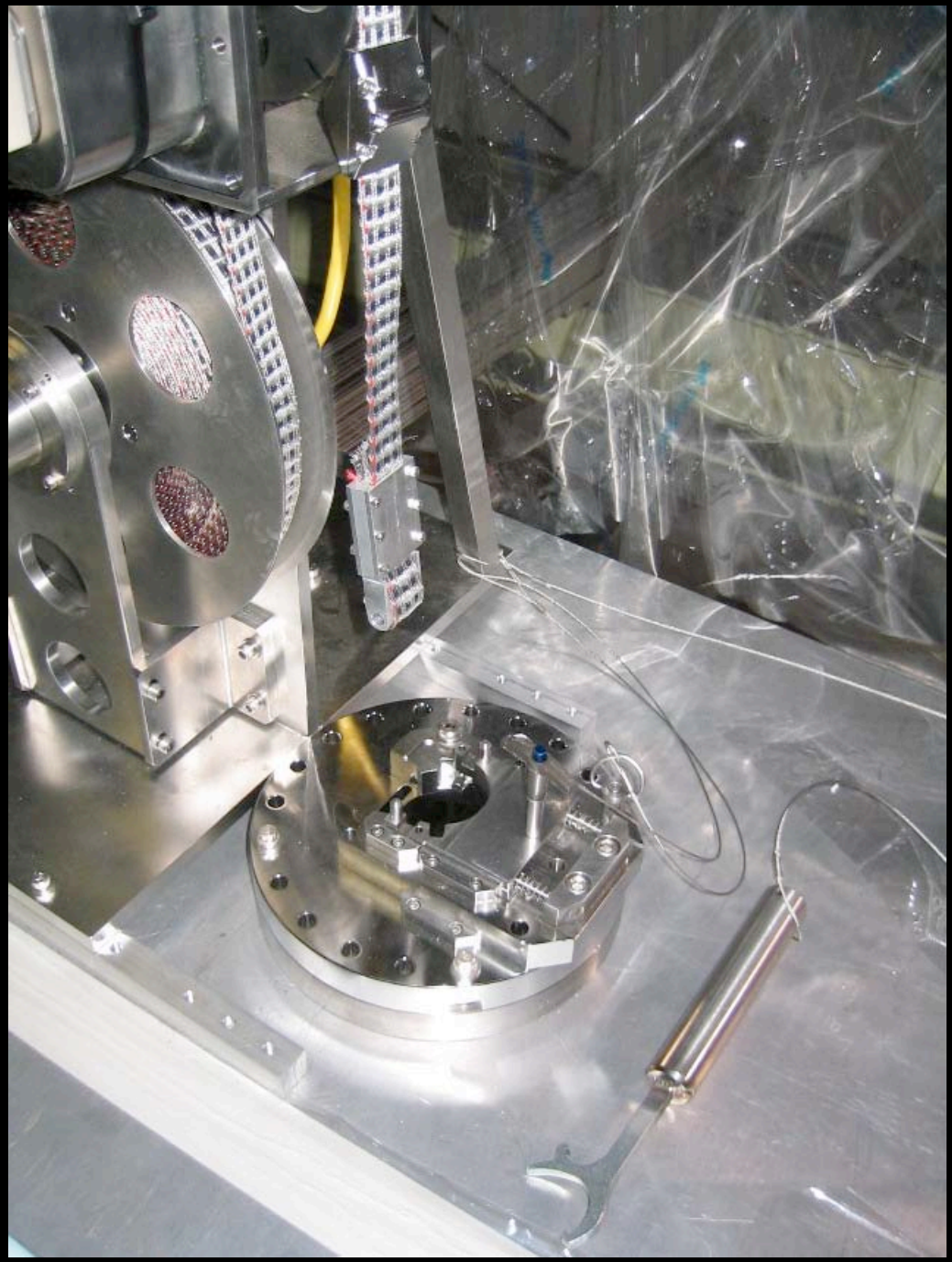
March 1, 2003
The “coat hanger” idea

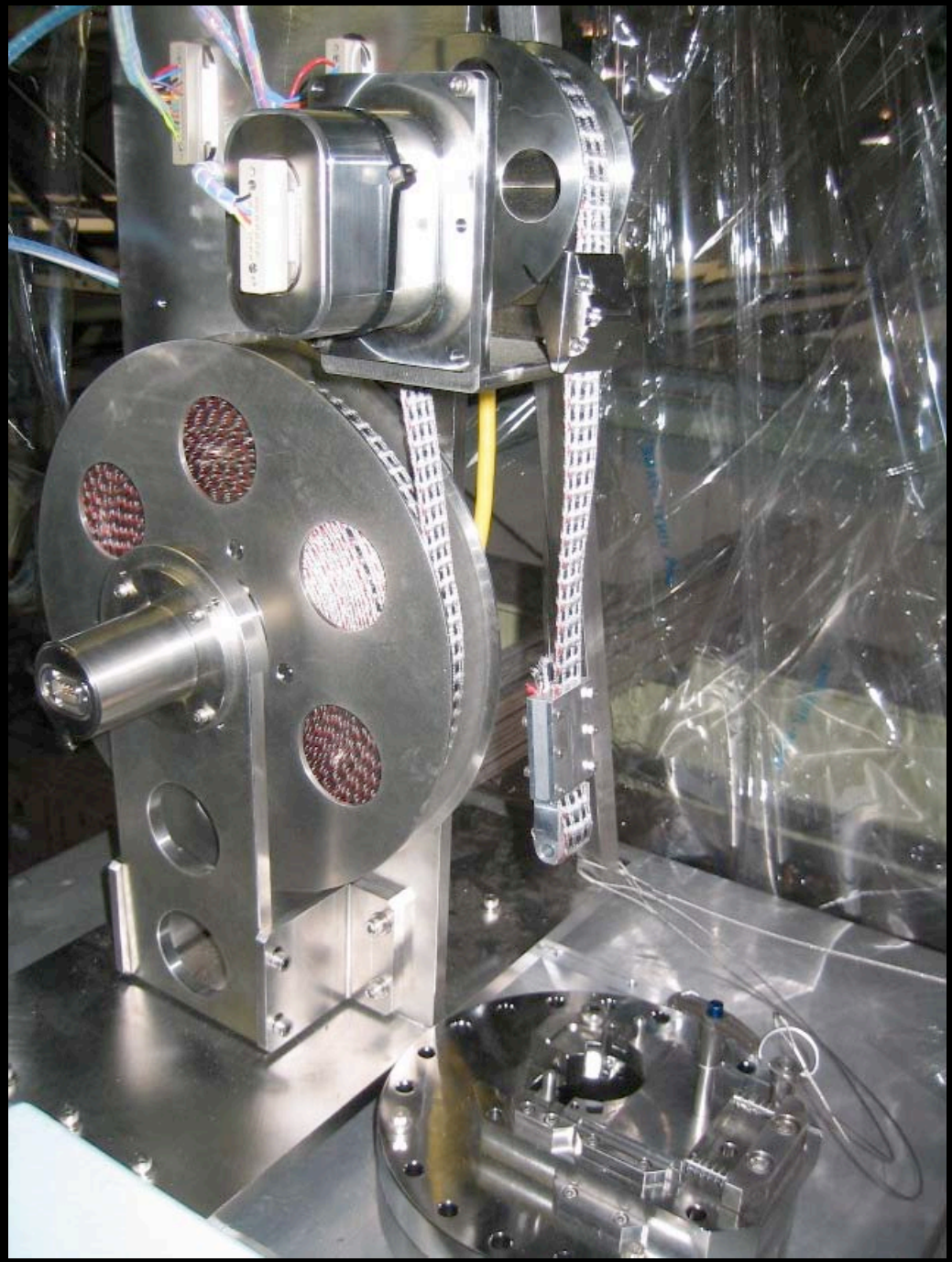
September 16, 2004
Full test of deployment system

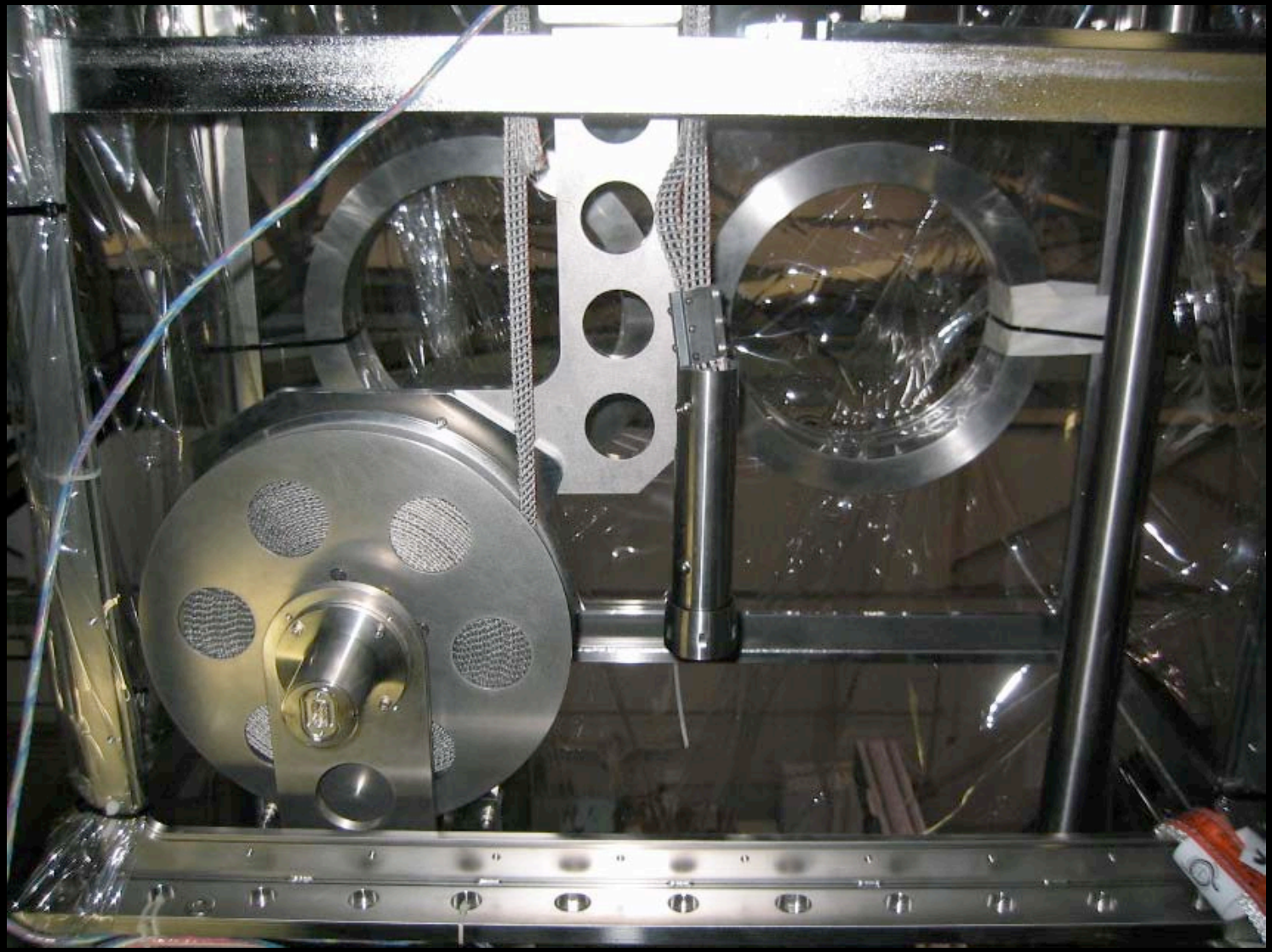


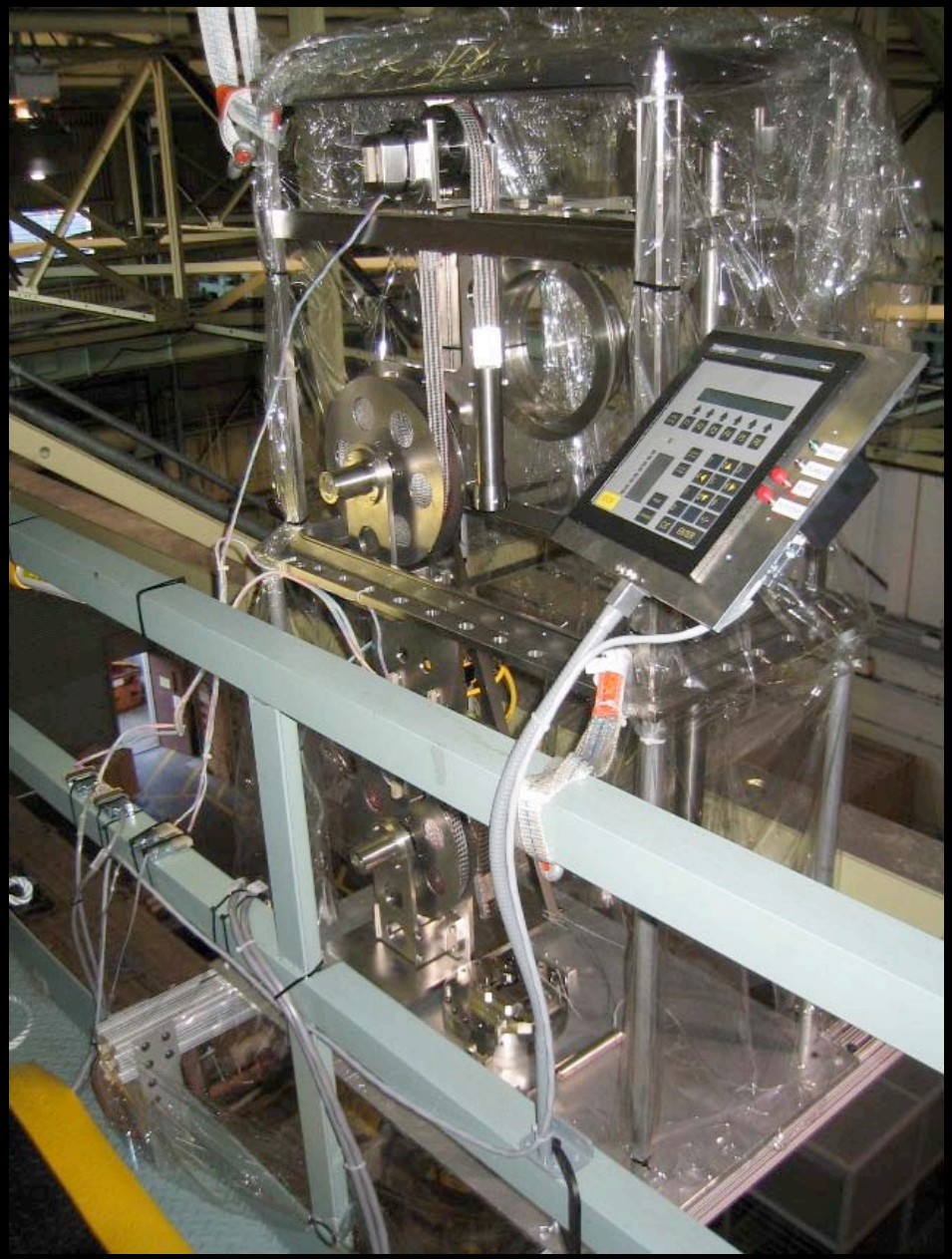




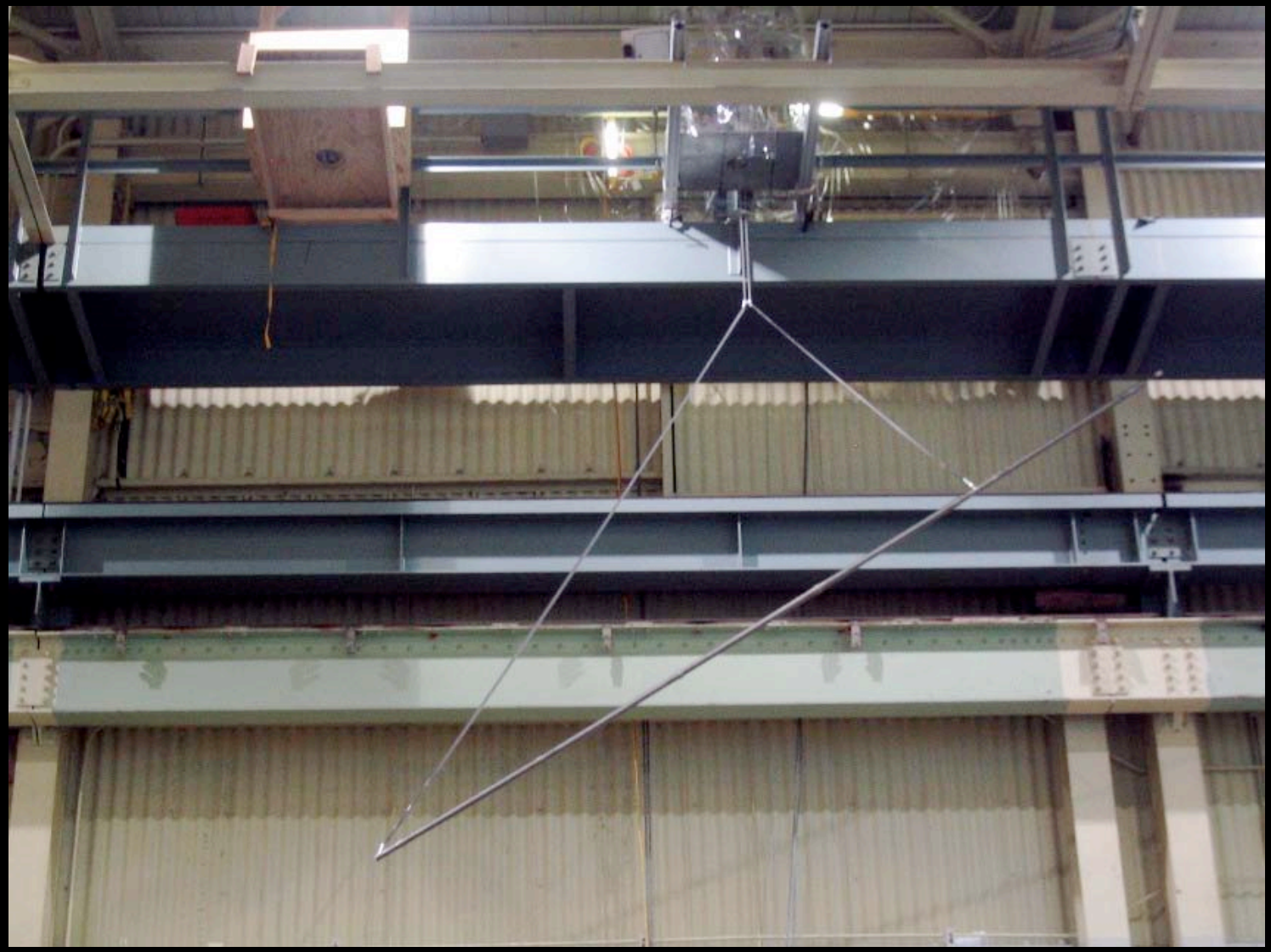




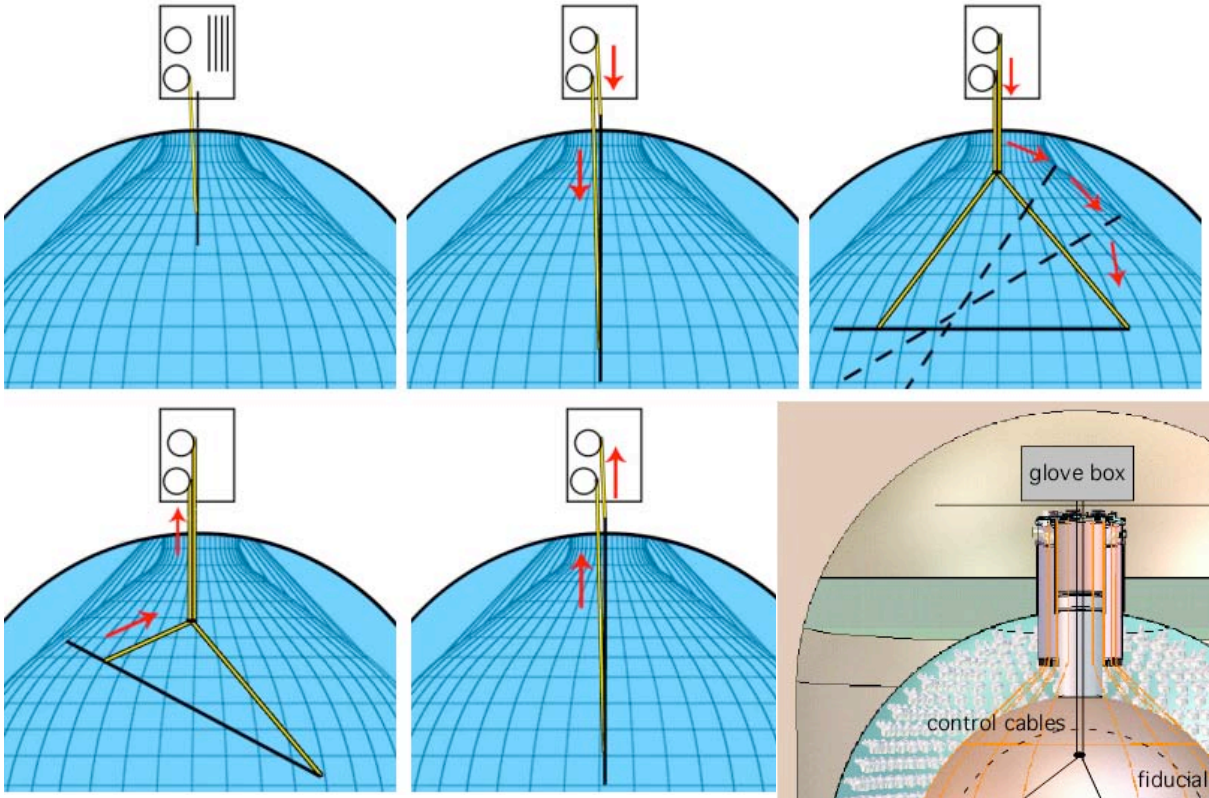





Compumotor
RP240
Parker
AXIS 2: L/R
HI 10.0000
AXIS SELECT: U/D
EDIT JOG+
MENU RECALL
F1
F2
F3
F4
F5
F6
POWER
CONTRAST INCREASE
CONTRAST DECREASE
1
2
3
4
5
6
7
8
9
0
.
+/-
PAUSE
CONTINUE
C/E
ENTER
STOP
ENABLED
DISABLED
RESET
STOP

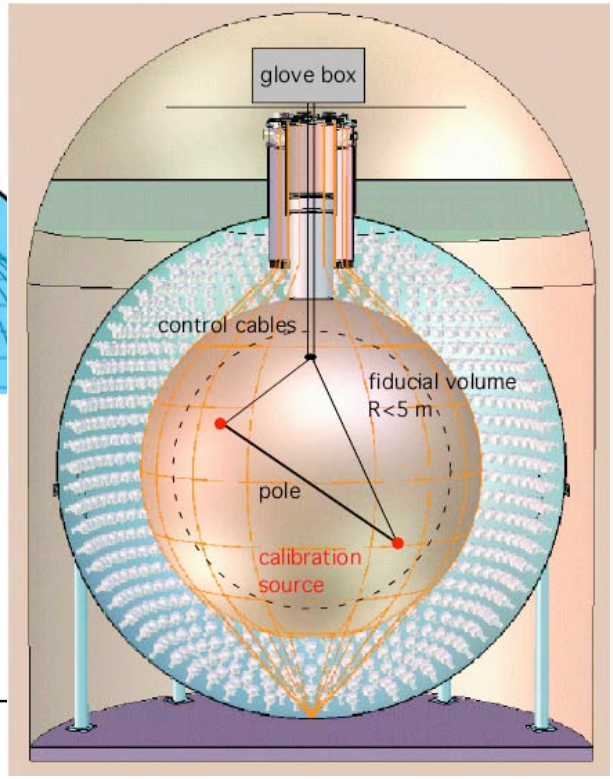


Calibration throughout entire detector volume



Fiducial volume:
R < 5 m

ΔR_{FV} = 5 cm
→ ΔV= 3%



Position Dependence of Detector Response

Event energy	$E(r,\theta,\phi)$
Vertex reconstruction	$R_{fit}(r,\theta,\phi)$

Off-Axis Calibration System

I. Hardware

Glovebox System and
Deployment Hardware

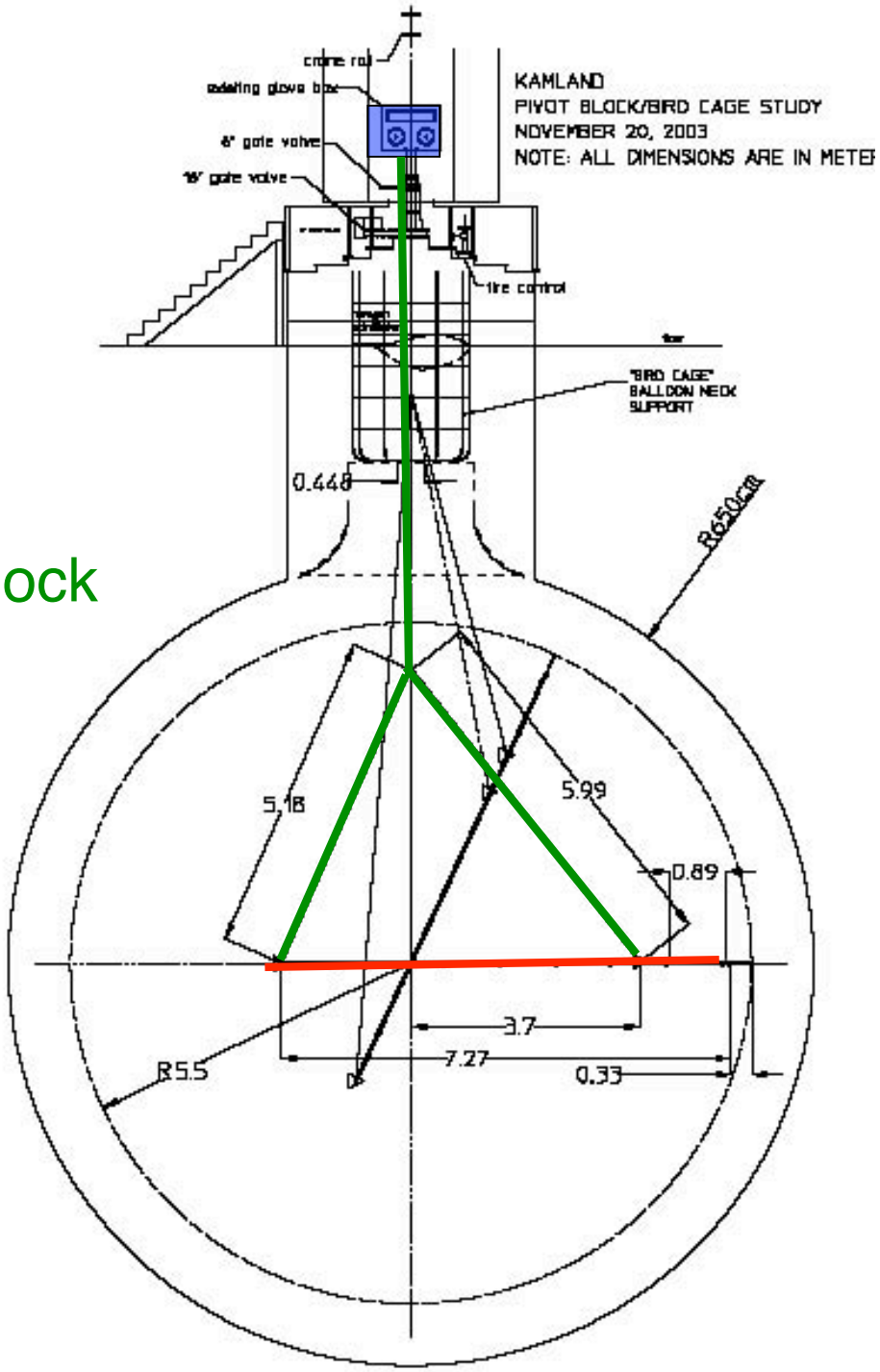
Control Cable + Pivot Block

Calibration Pole

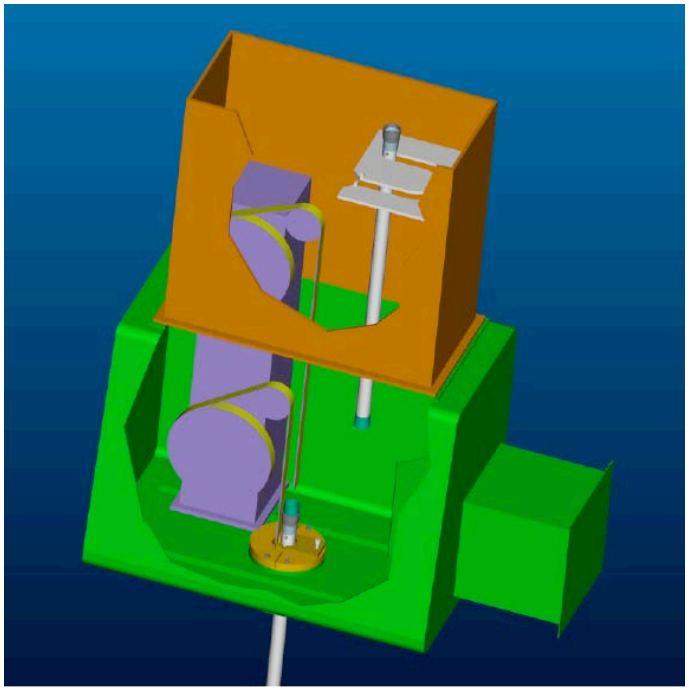
II. System Control Software

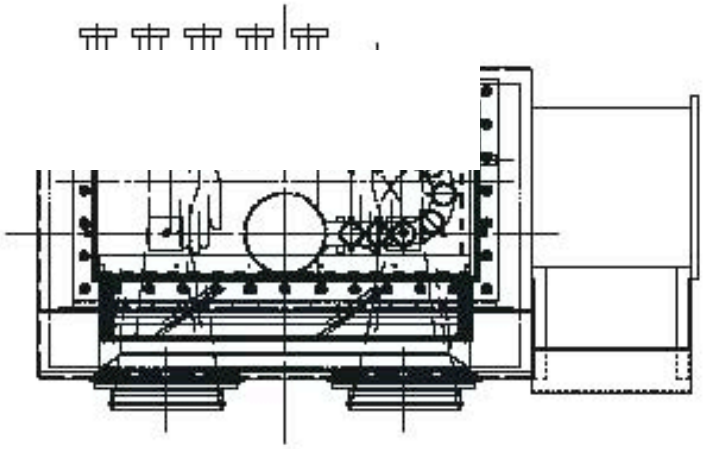
→ Fred Gray

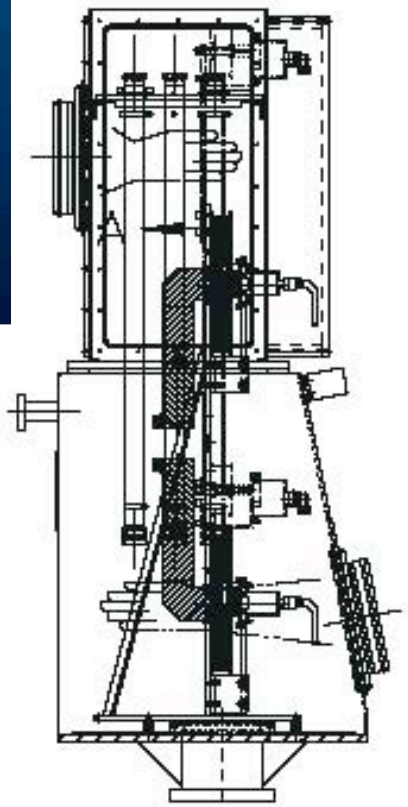
III. Position Reconstruction

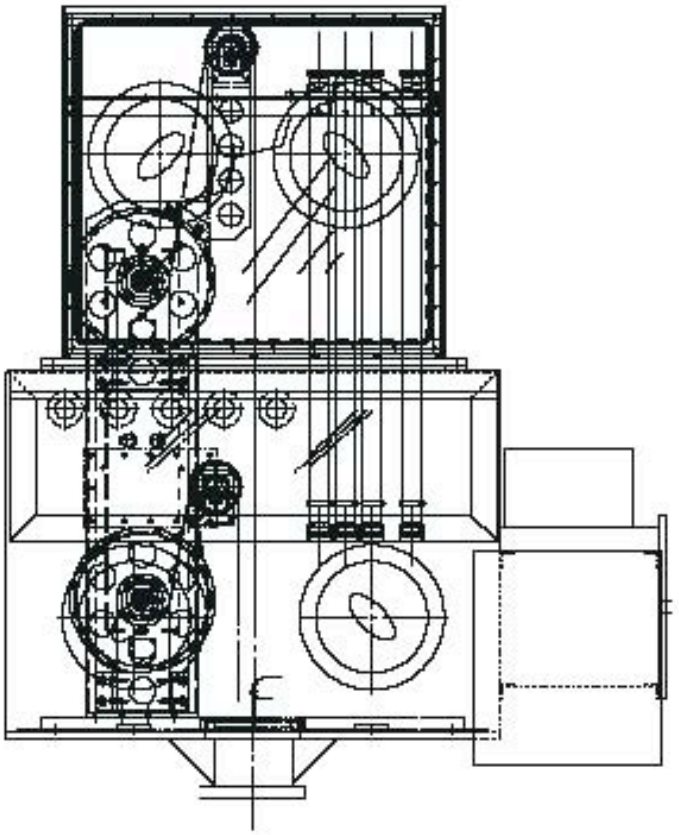


Glovebox System and Deployment Hardware

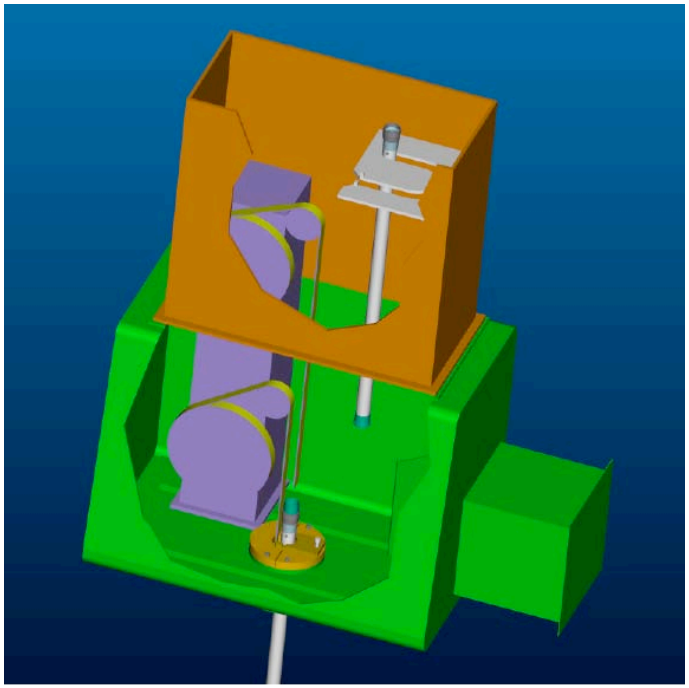


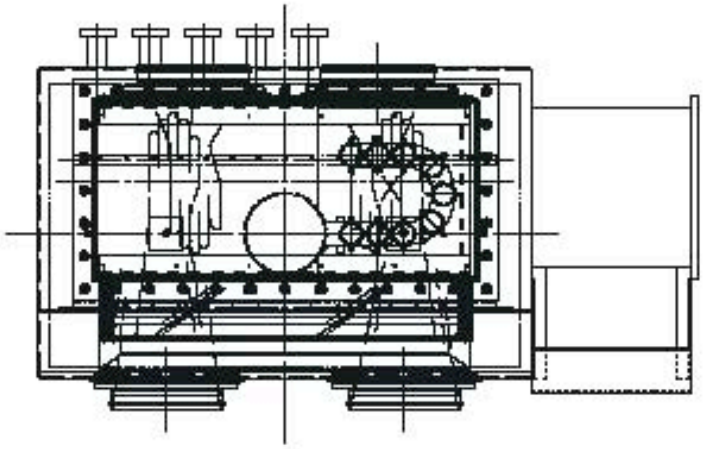




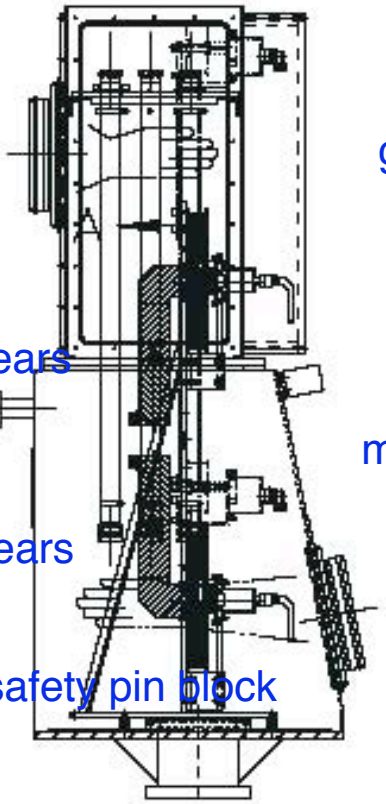


Glovebox System and Deployment Hardware





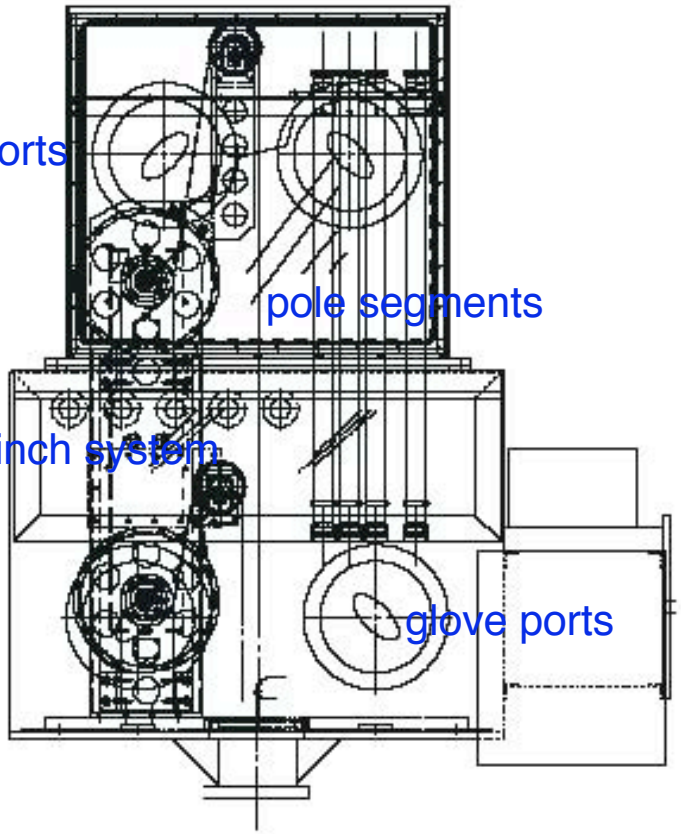
glovebox extension - penthouse



motors + gears

motors + gears

safety pin block

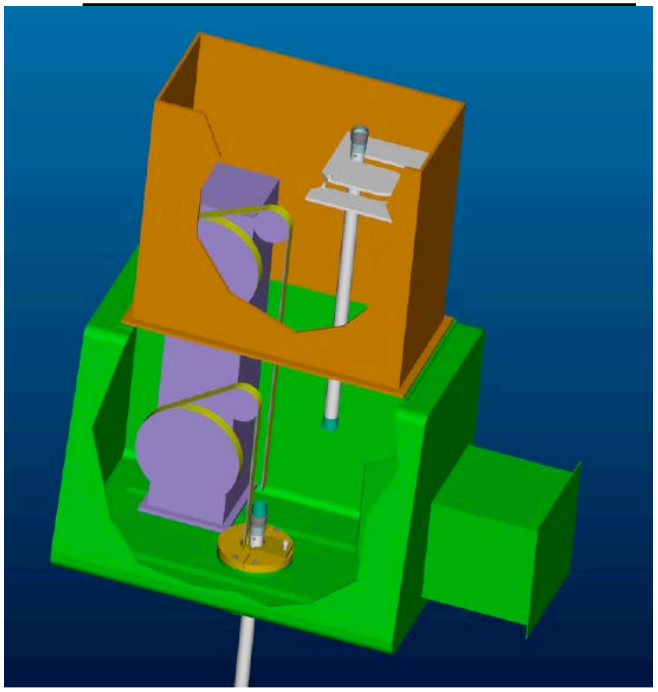


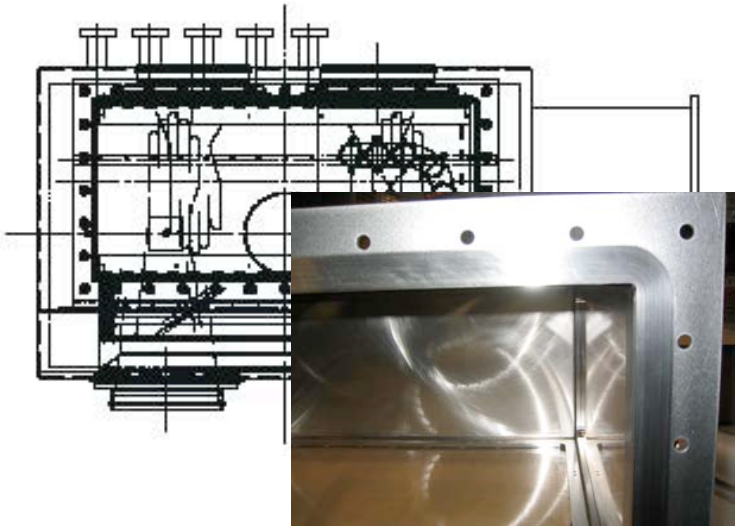
glove ports

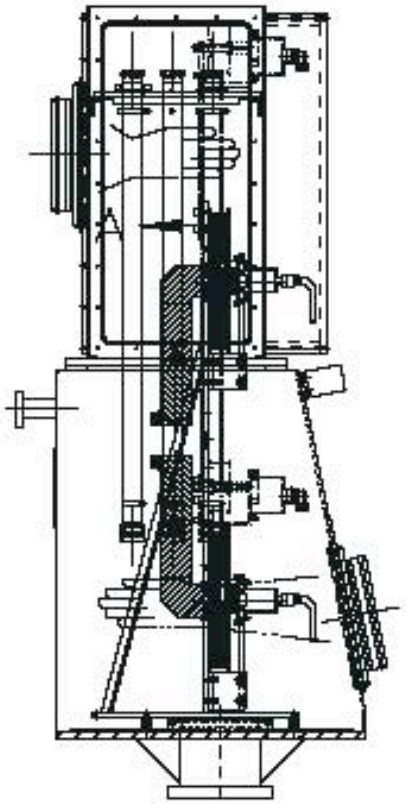
pole segments

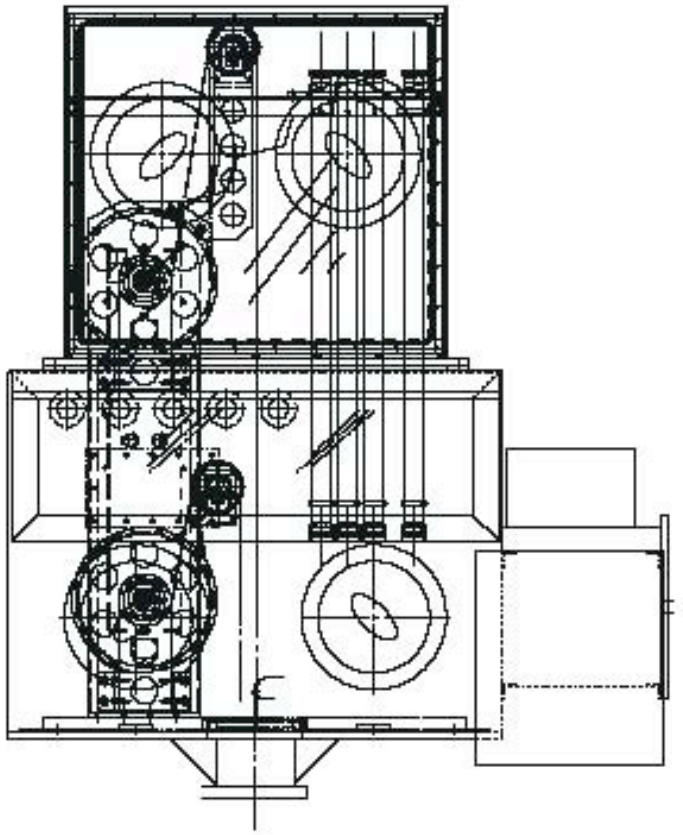
motor winch system

glove ports

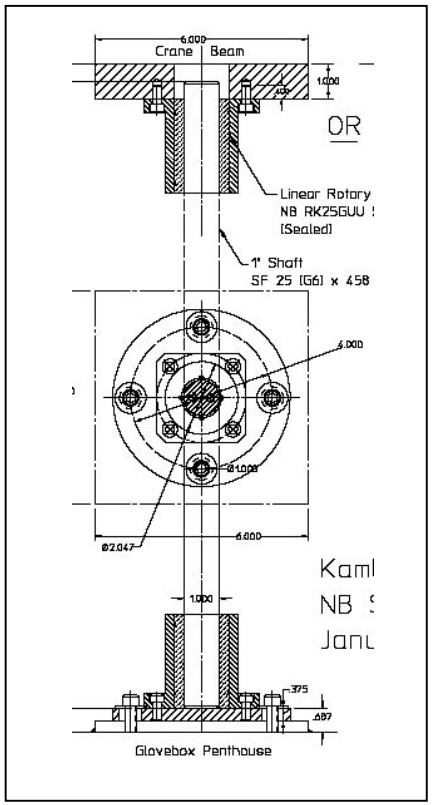


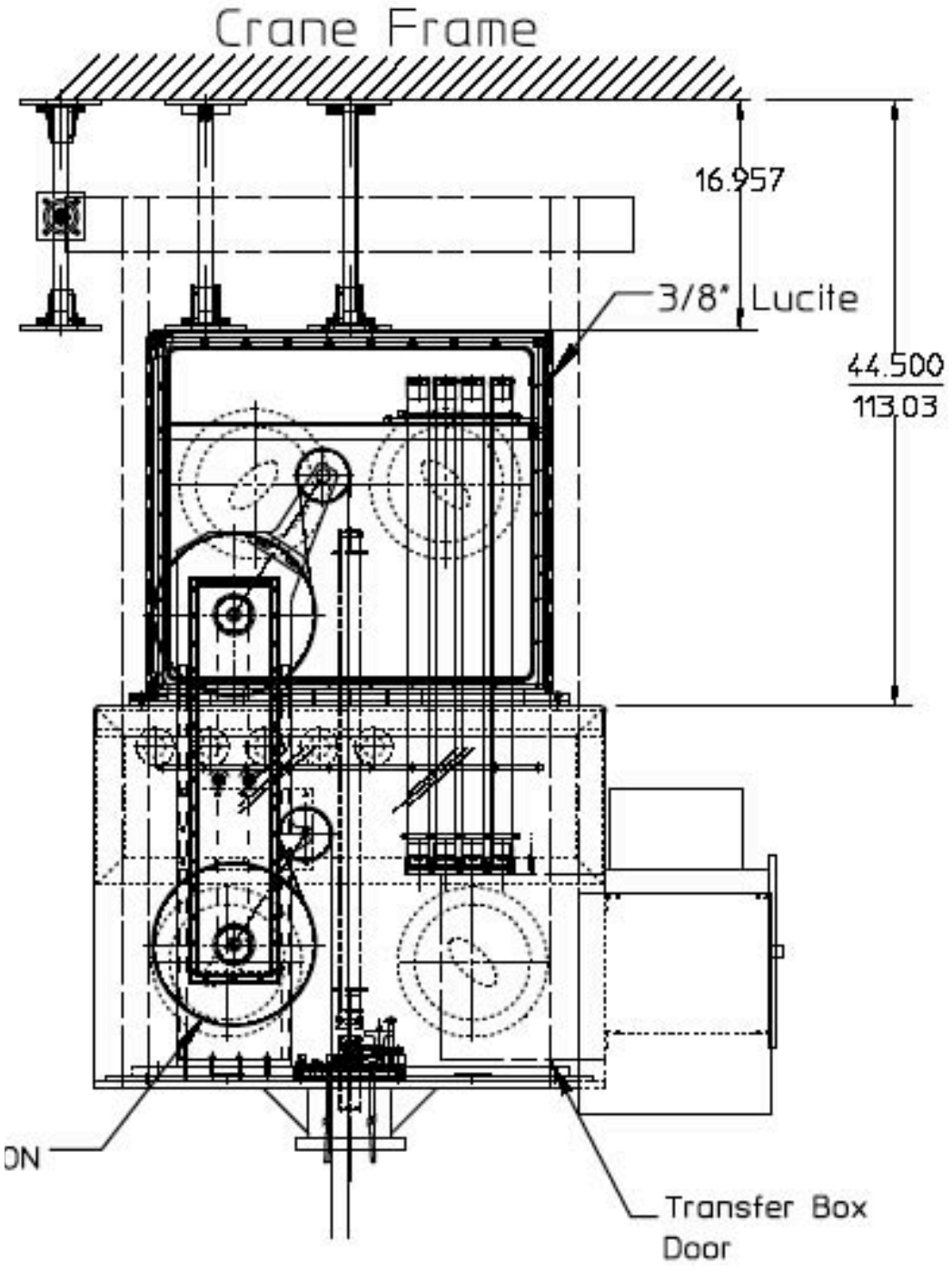






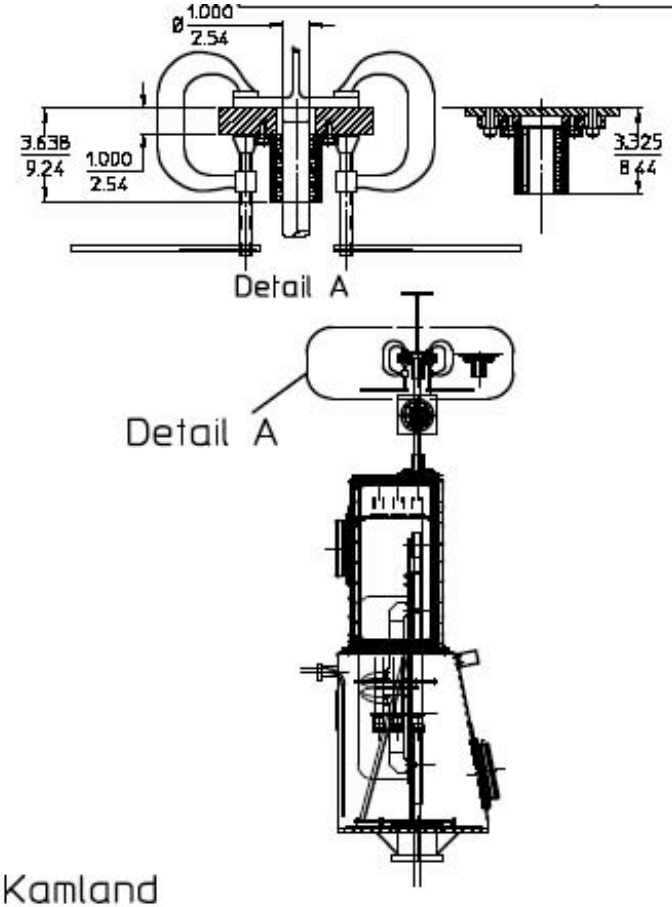
Glovebox Axial Support





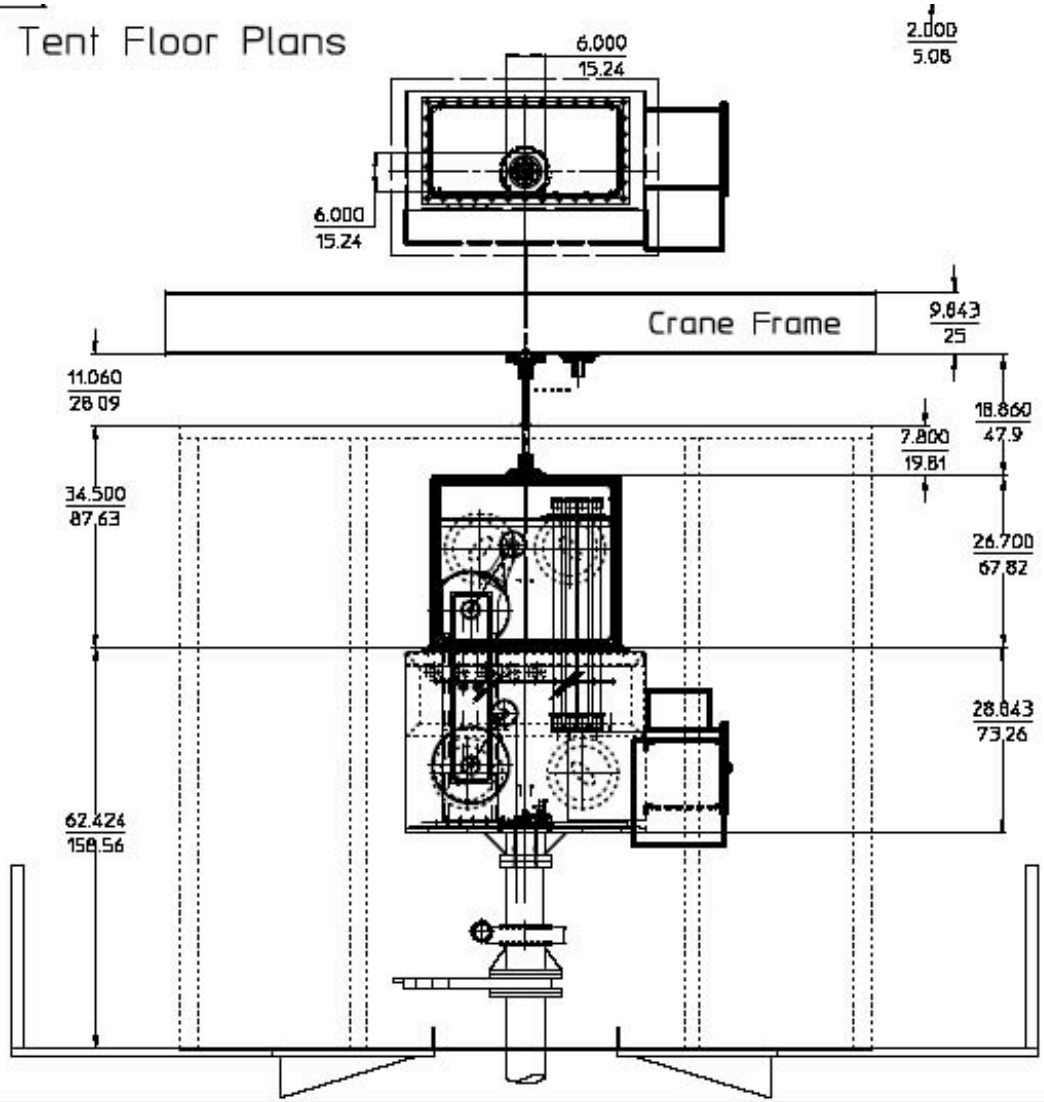
- provides axial stability
- allows system to rotate
- avoids future problems with rotary stage

Glovebox Axial Support

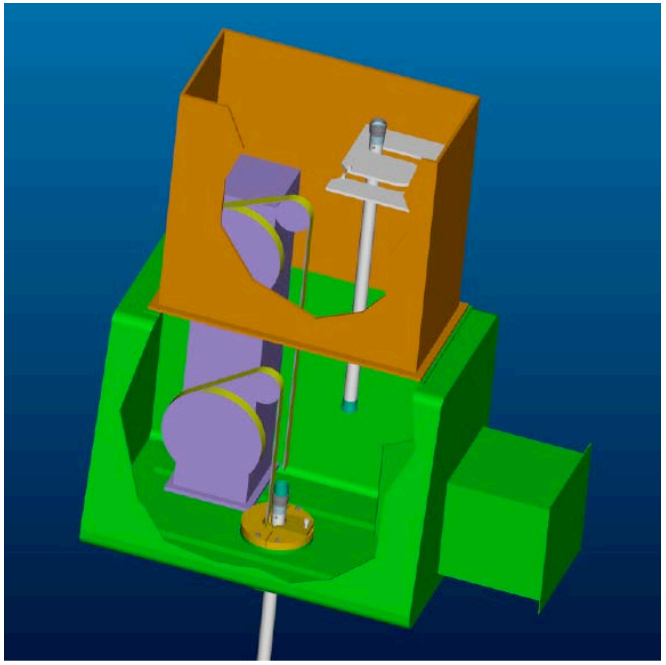


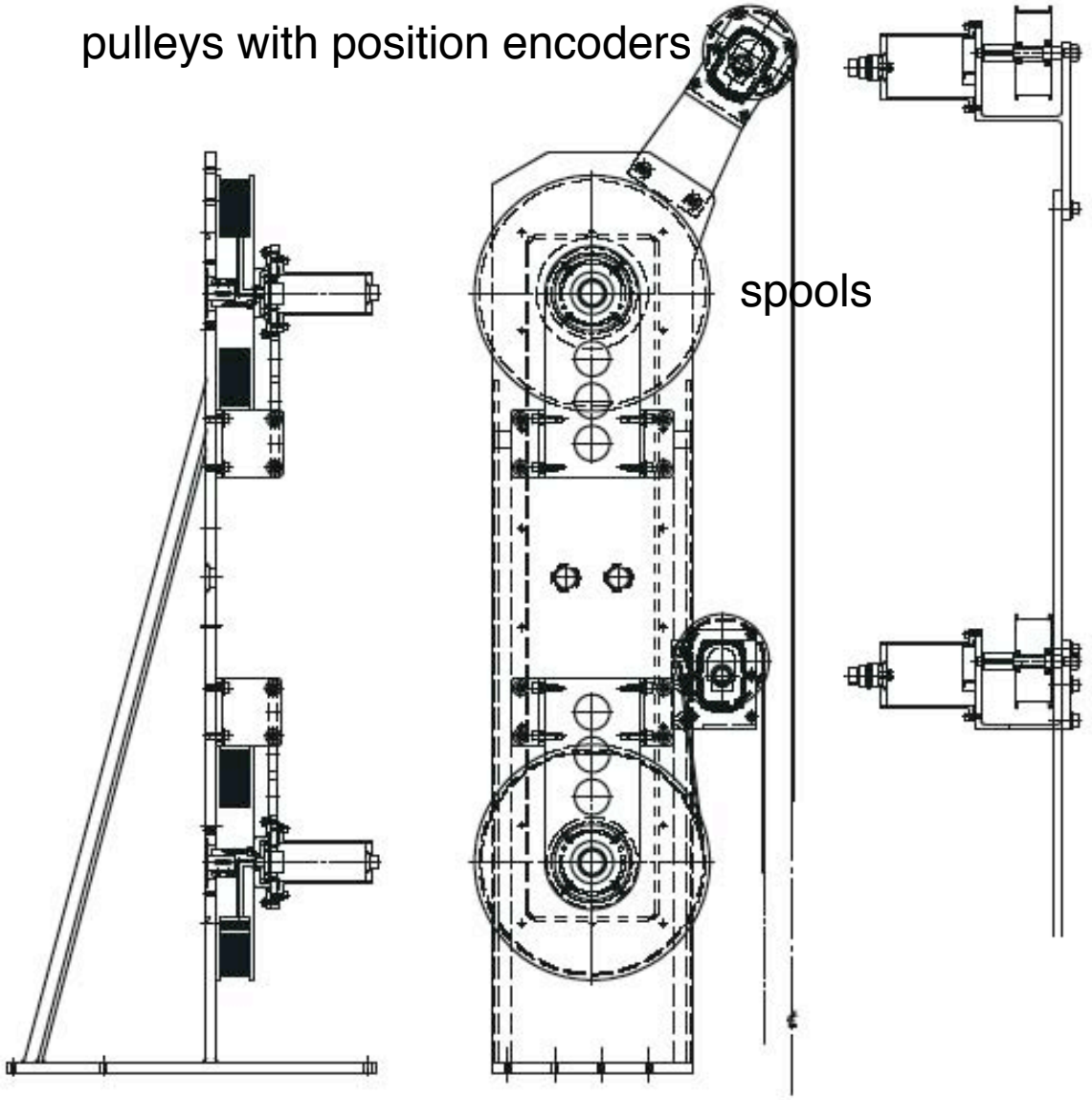
Kamland
Glovebox Support Bearing Layout
January 20, 2004

Note: All dimensions are in inches over centimeters.

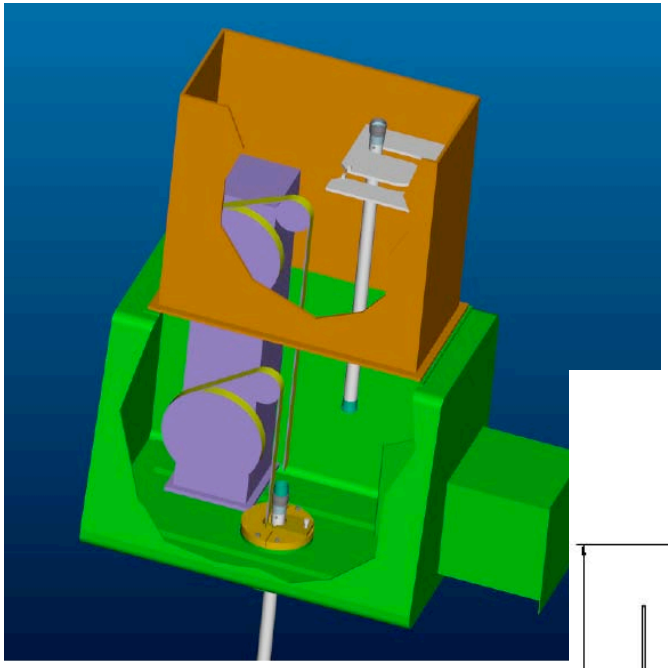


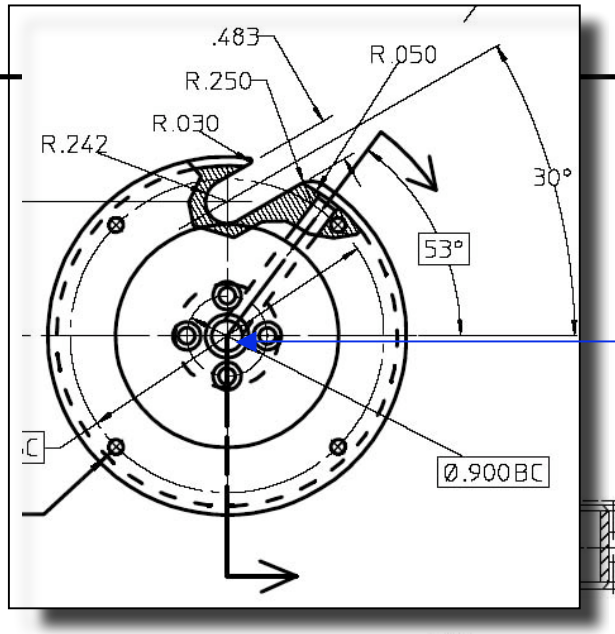
Motor Drive System



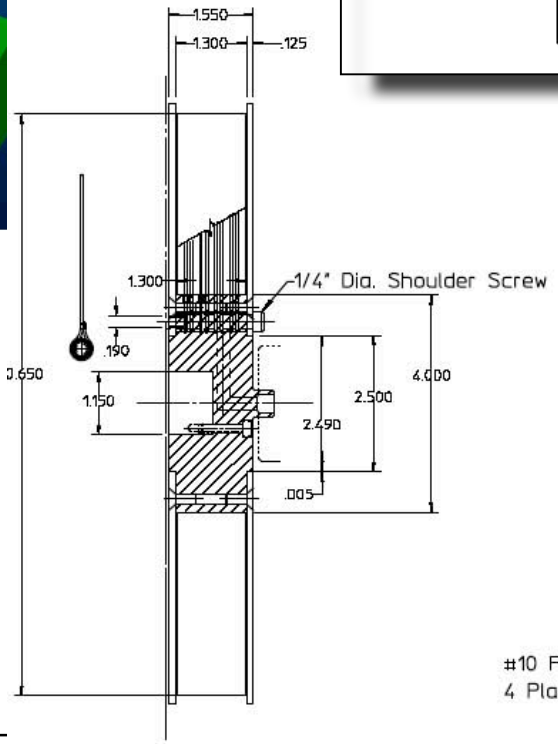


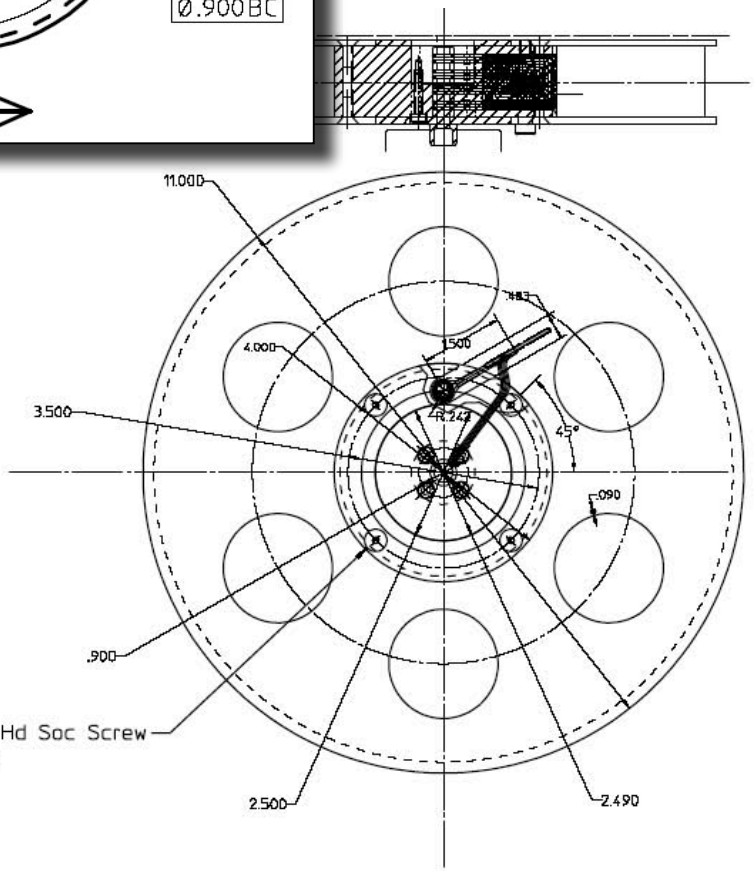
Spools



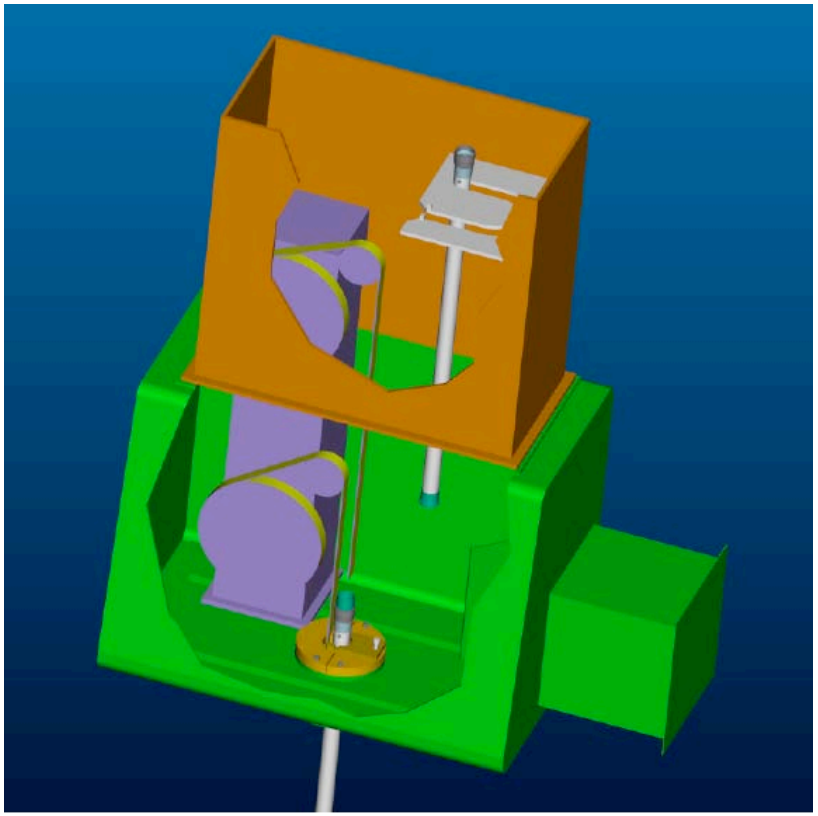


enclosed slip ring with electrical connections

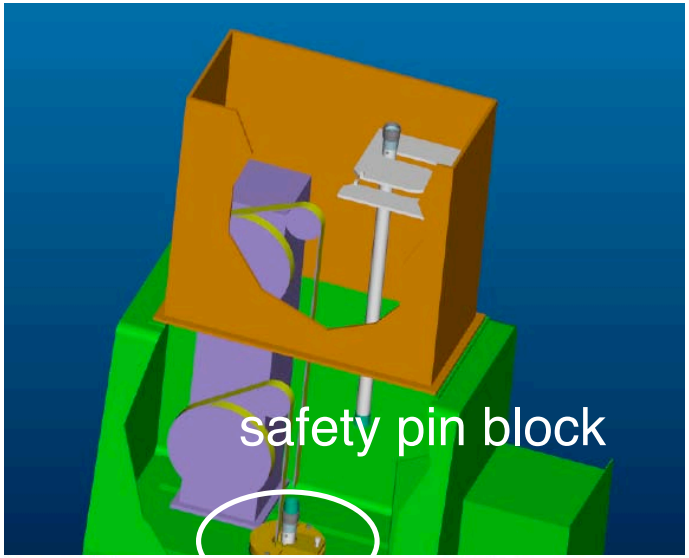




Glovebox System and Deployment Hardware



Safety Pin Block

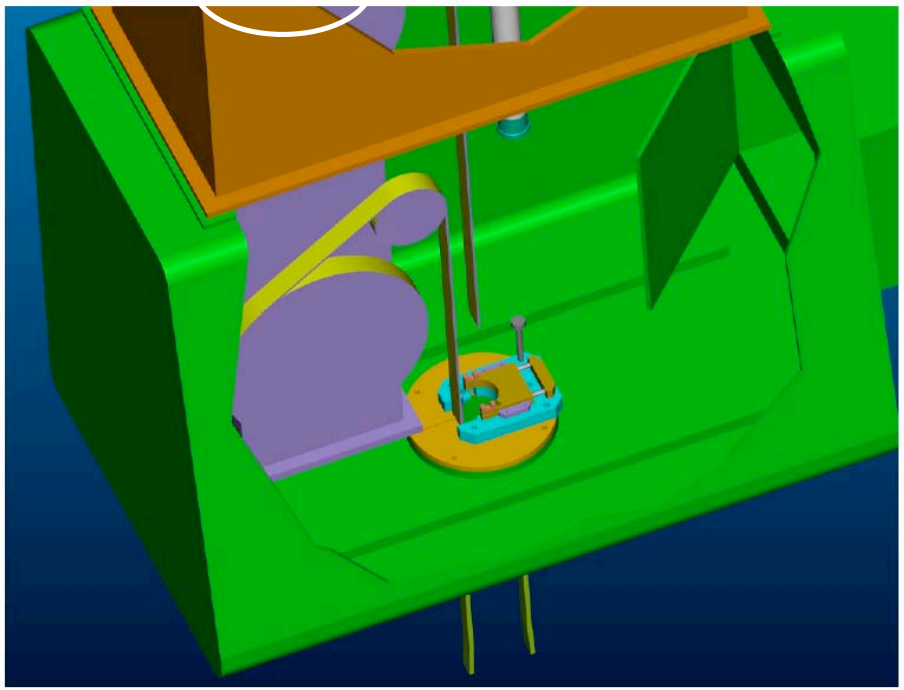


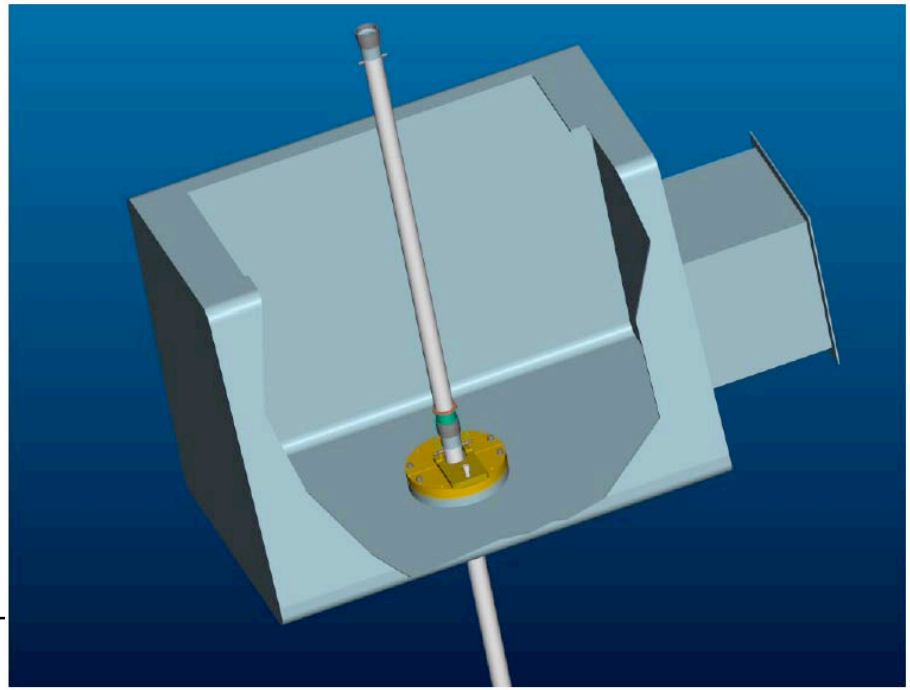
Purpose

I. Safety block between glovebox and detector.

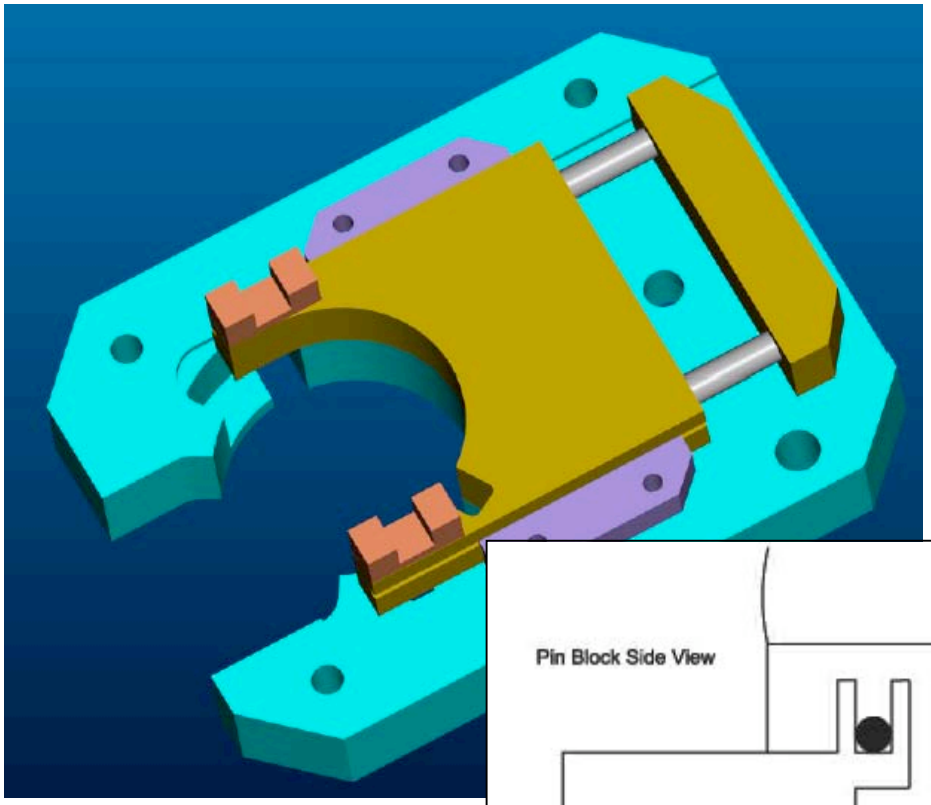
II. Used for assembly of pole.

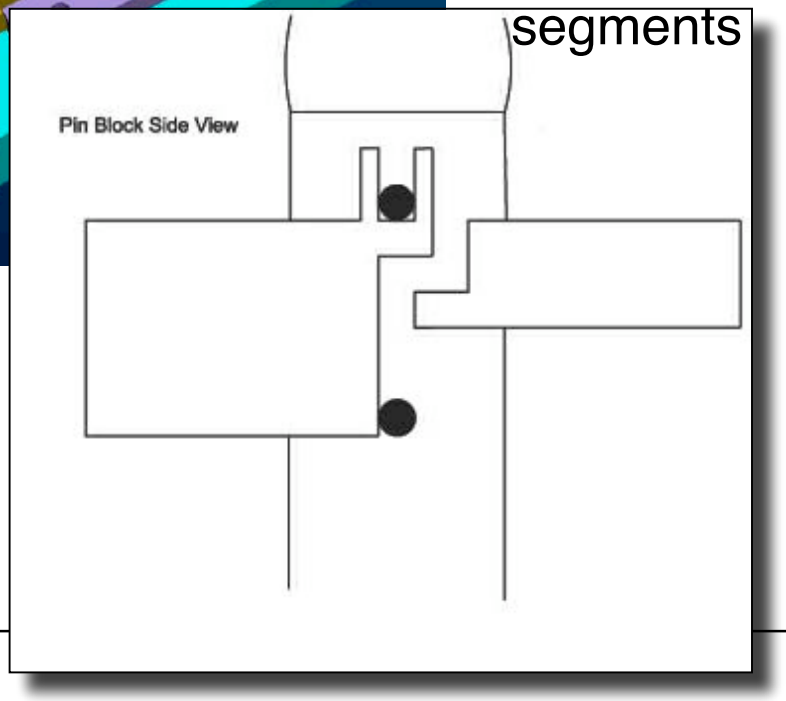
III. Allows easy retrieval of pole.





Safety Pin Block





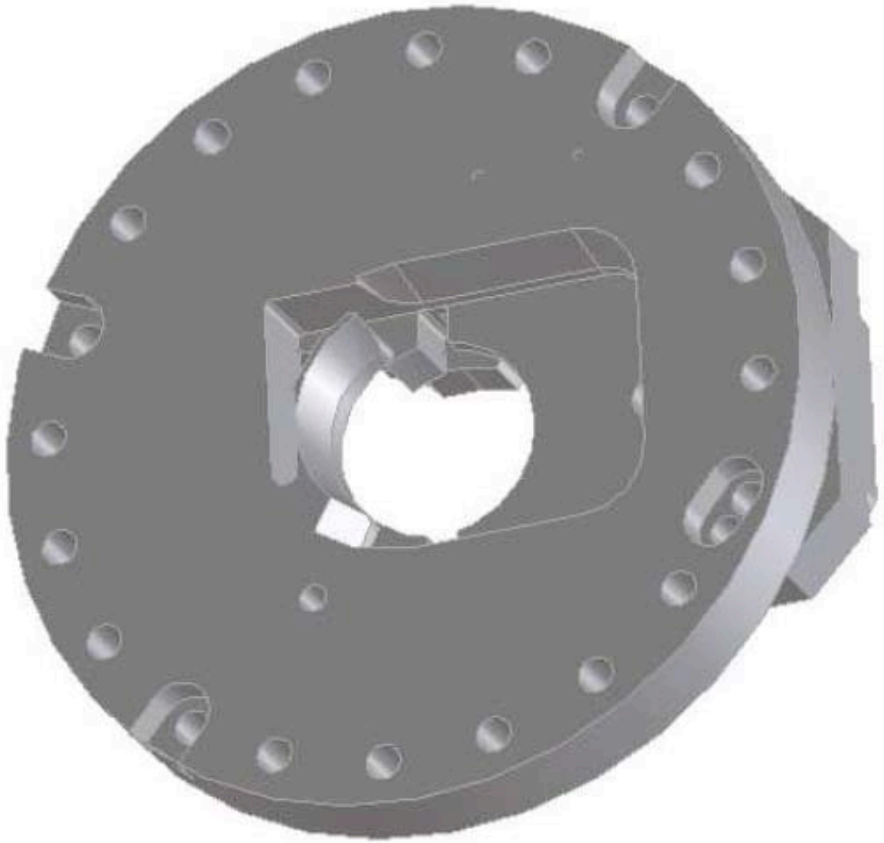
1. prevents pole segments from dropping into detector

2. operator needs to turn pole segment when engaged in safety pin block

3. sliding block allows easy retrieval of calibration pole segments

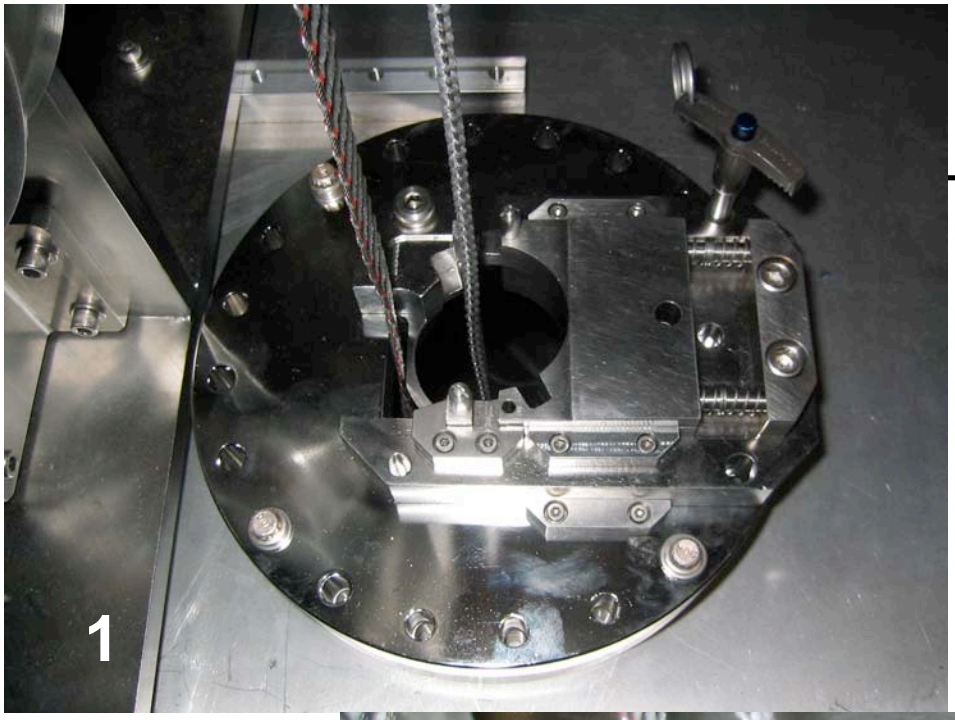
Parts

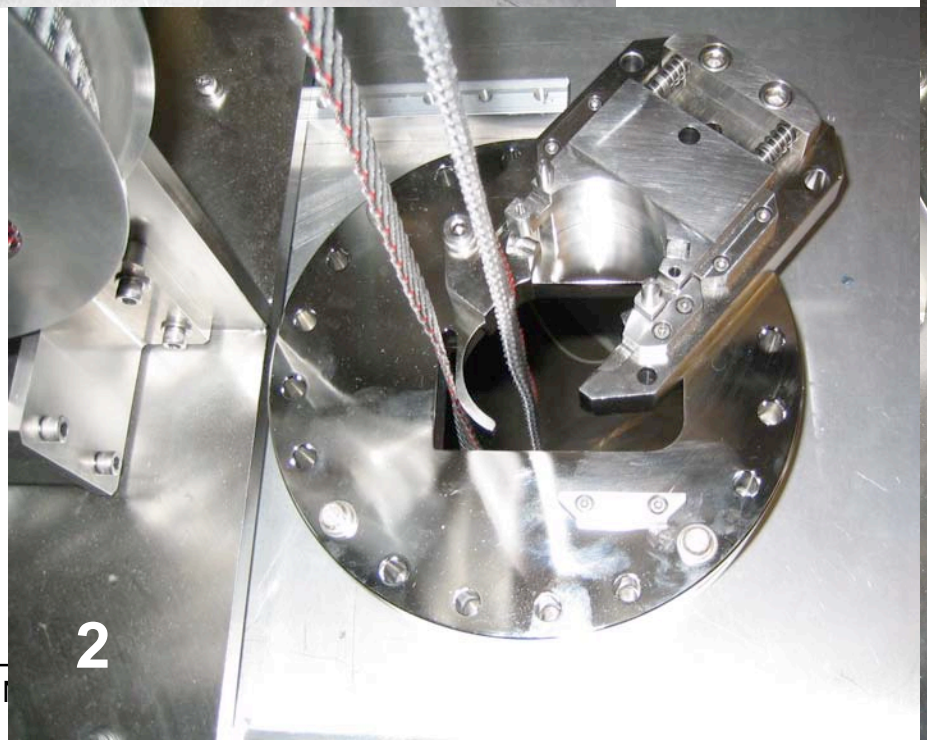
Bottom of Conflat

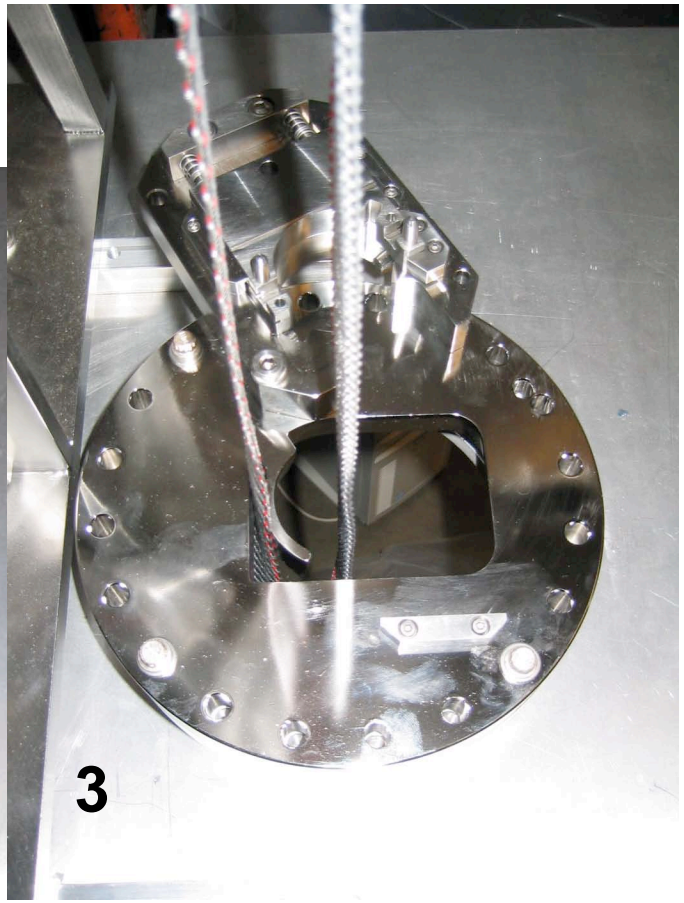


The New Pin Block

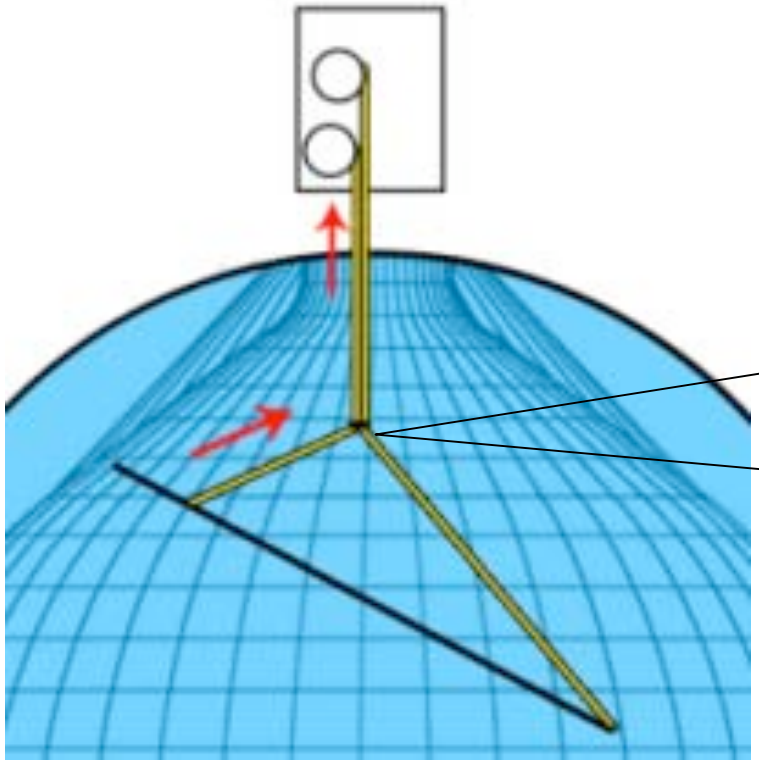
- mounted on conflat flange
- guides control cables
- rotates to allow pivot block to pass
- provides 3-step safety lock

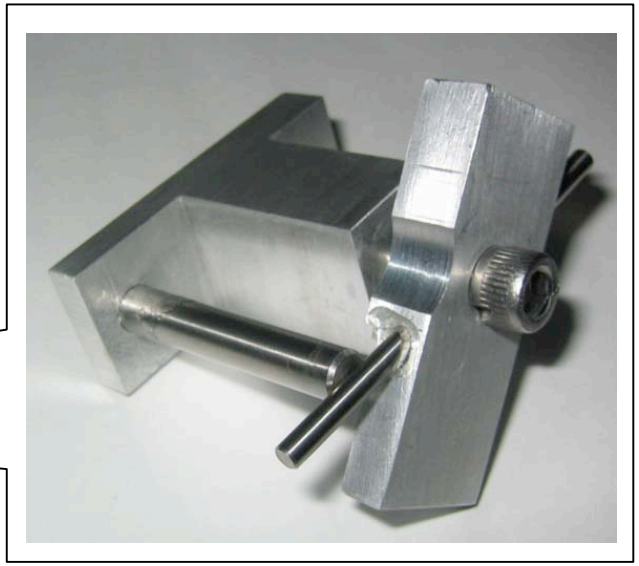






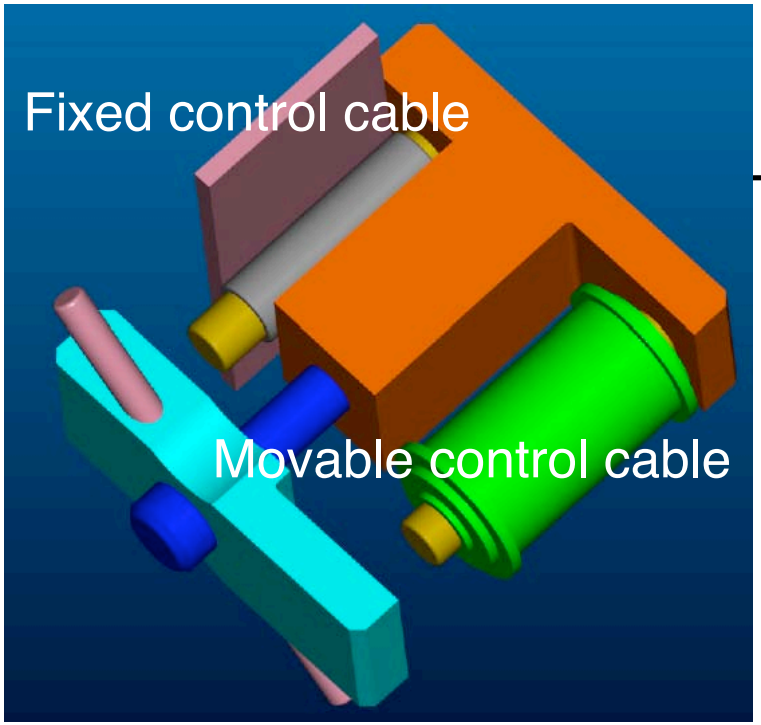
Pivot Block

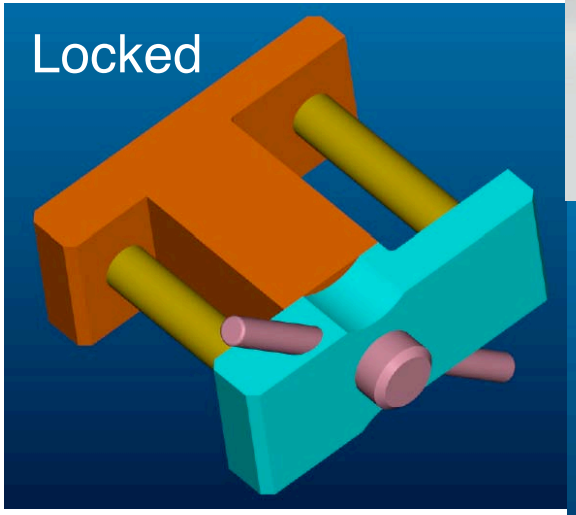




An essential part to control motion of system

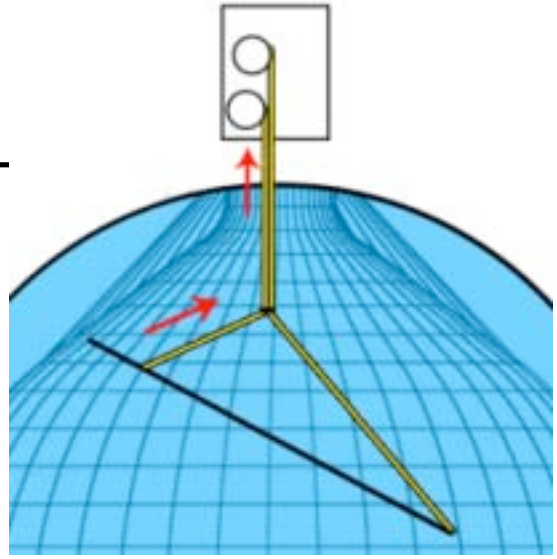
Pivot Block - Functionality

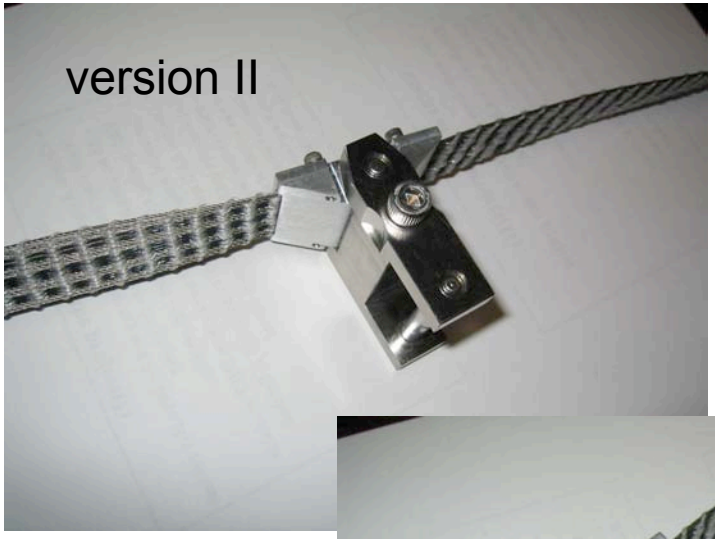




Pivot Block - Revisited

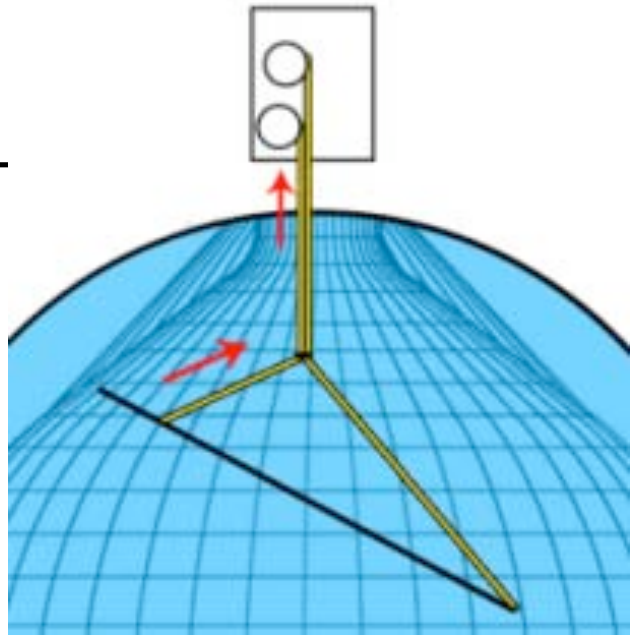
- consists of (1) pivot and (2) clamp
- uses cable clamp, no crimping
- adjustable positioning



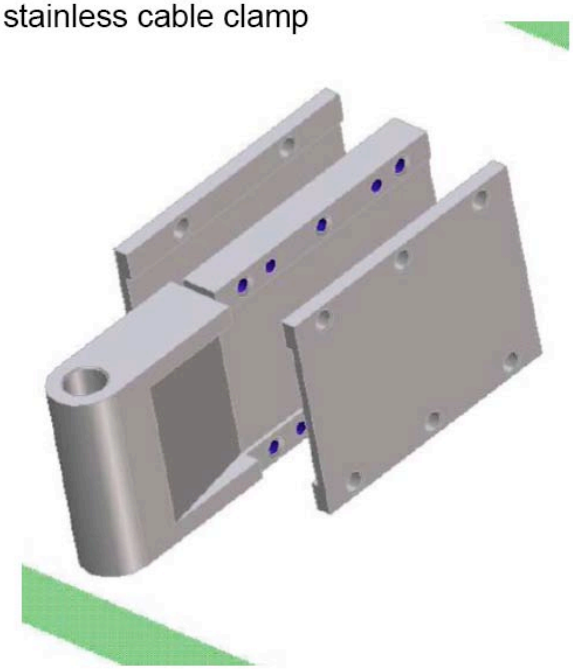


Cable Attachment

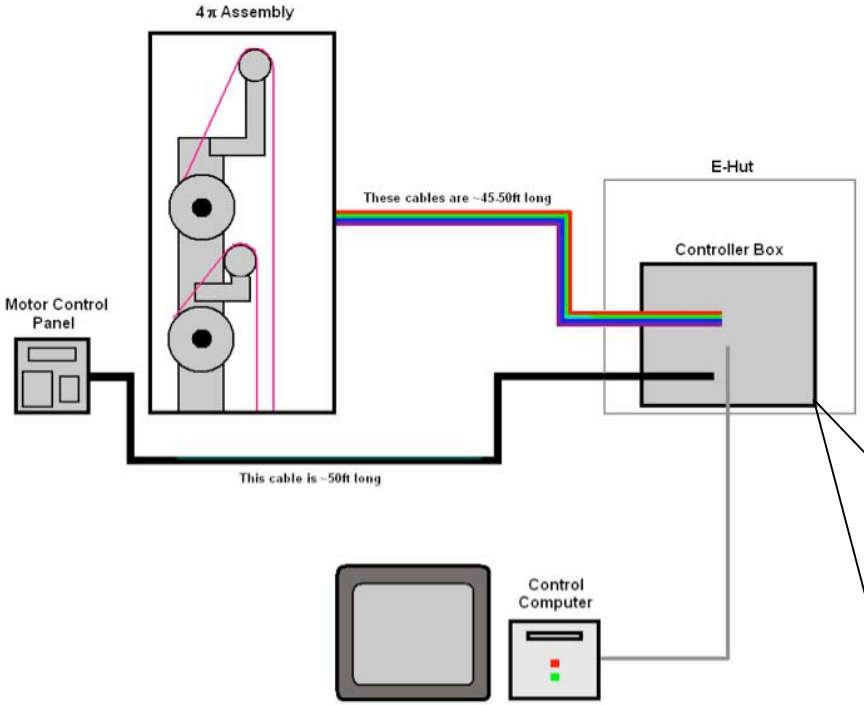
- modular
- allows easy replacement of cable
- greater stability and control

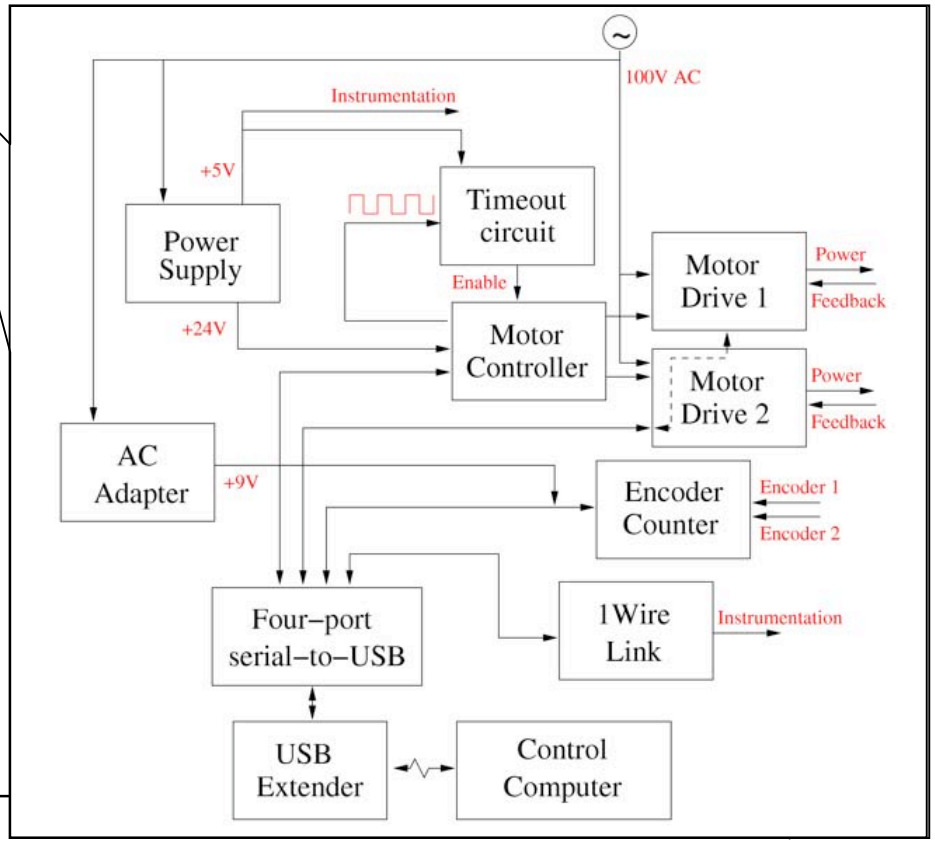


stainless cable clamp

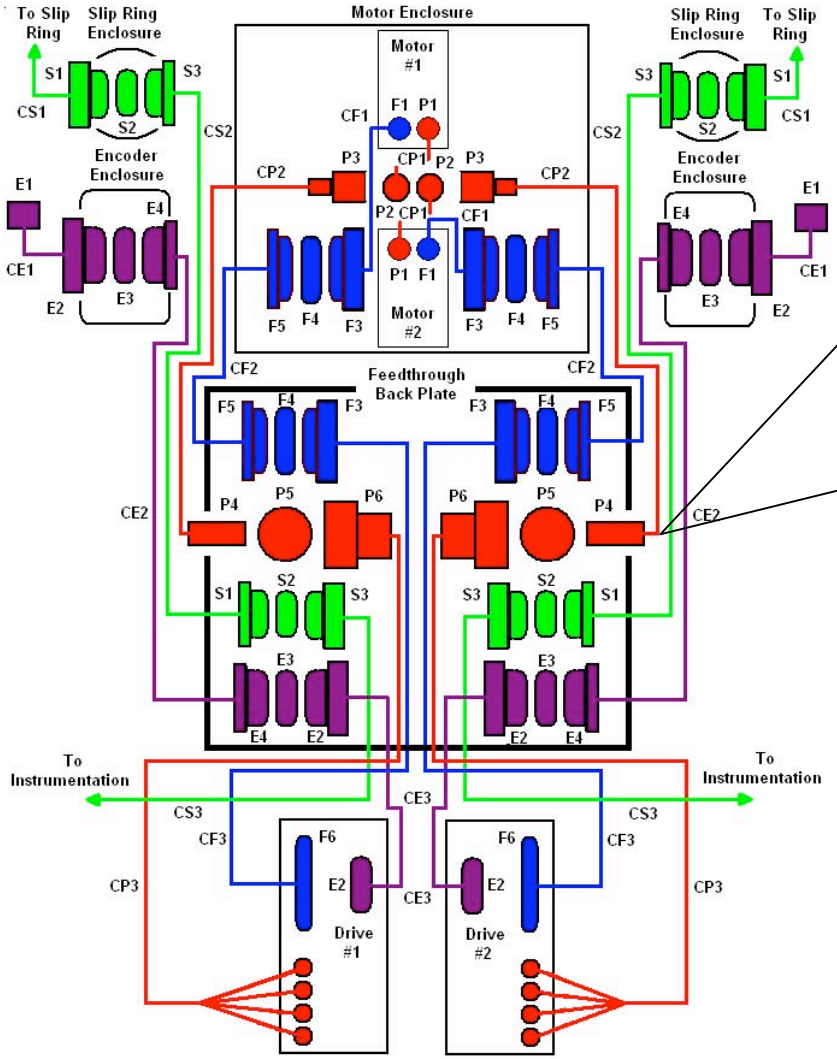


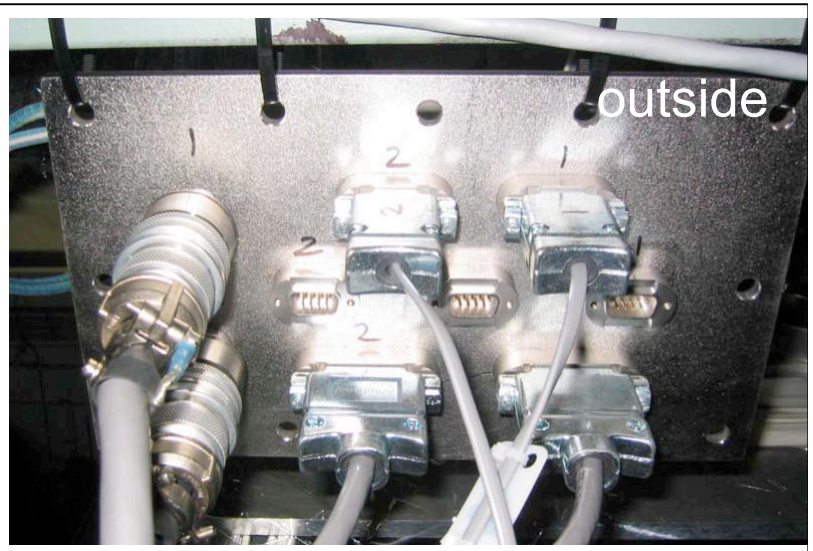
Electrical Cabling and Controls Systems

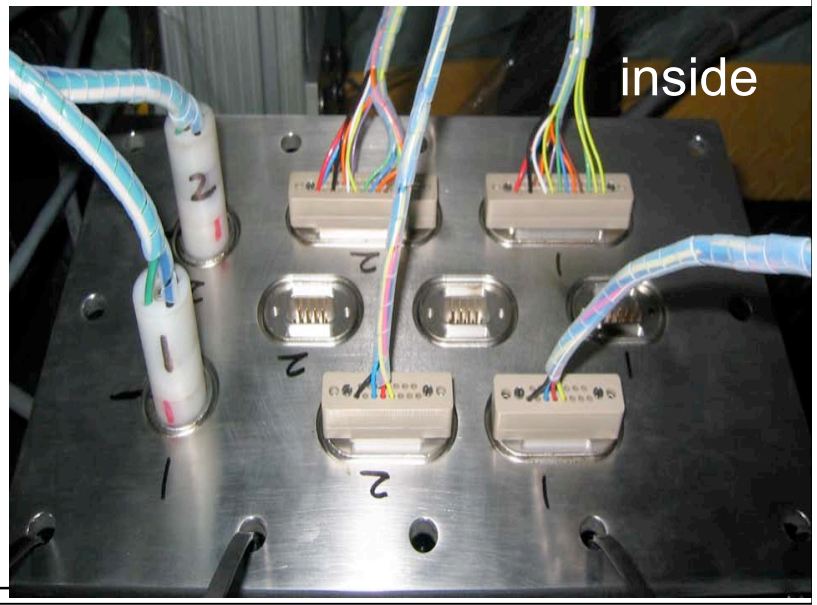




Electrical Cabling and Glovebox Feedthroughs

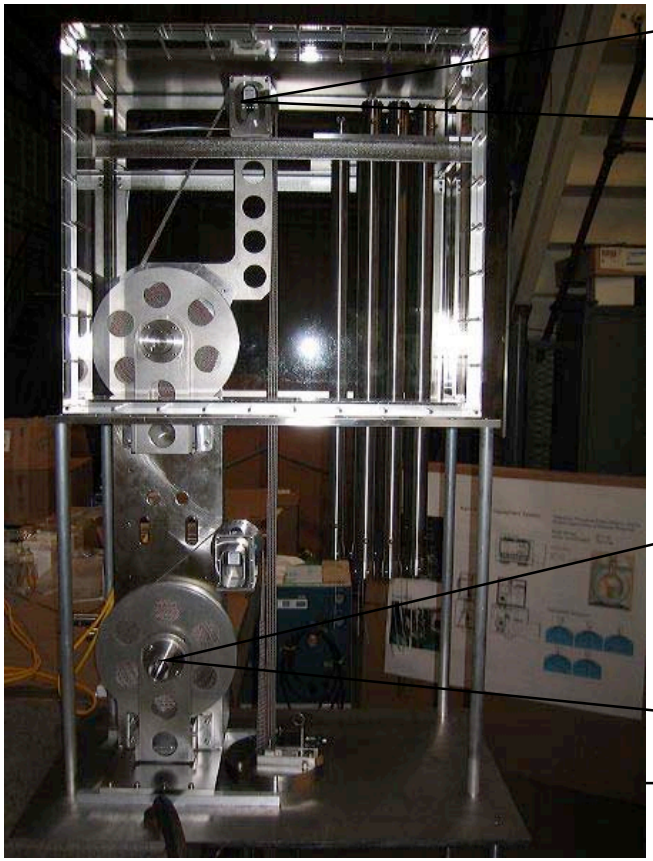


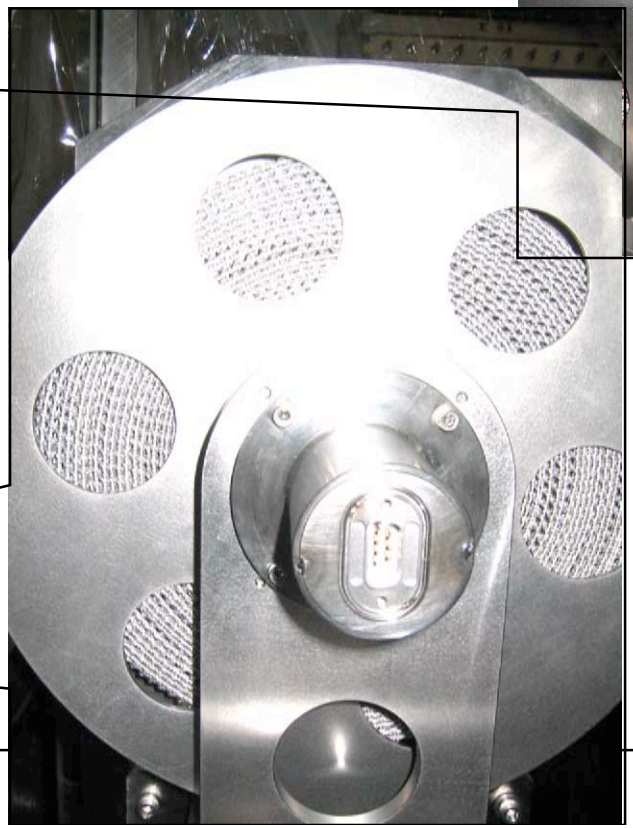




In-Glovebox Feedthroughs

Pulley encoders and slip rings completely encapsulated



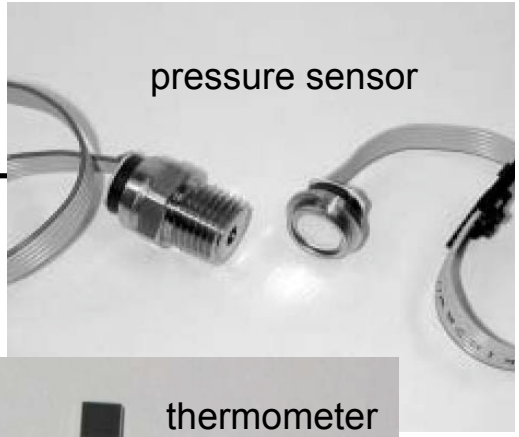


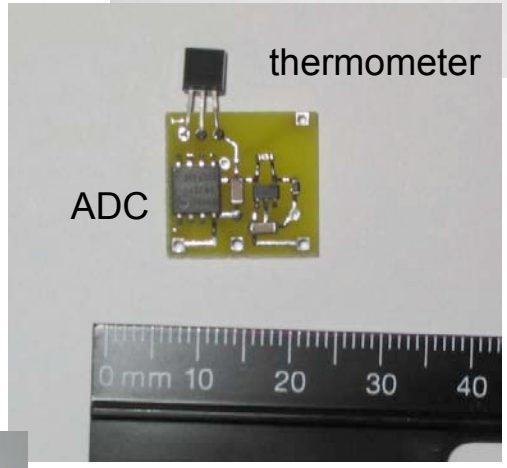
Instrumentation Unit

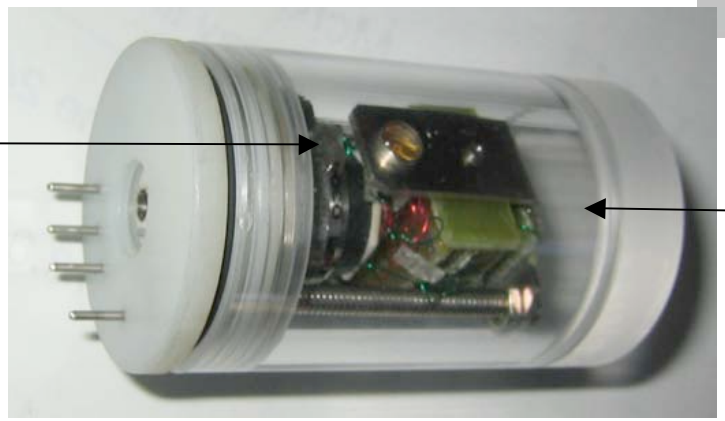
- prototype completely assembled, being tested

- uses total of 3 wires in control cable

- 4 functions:
  1. reads out pressure sensor
  2. controls LEDs
  3. measures temperature
  4. Inclinometer and accelerometer



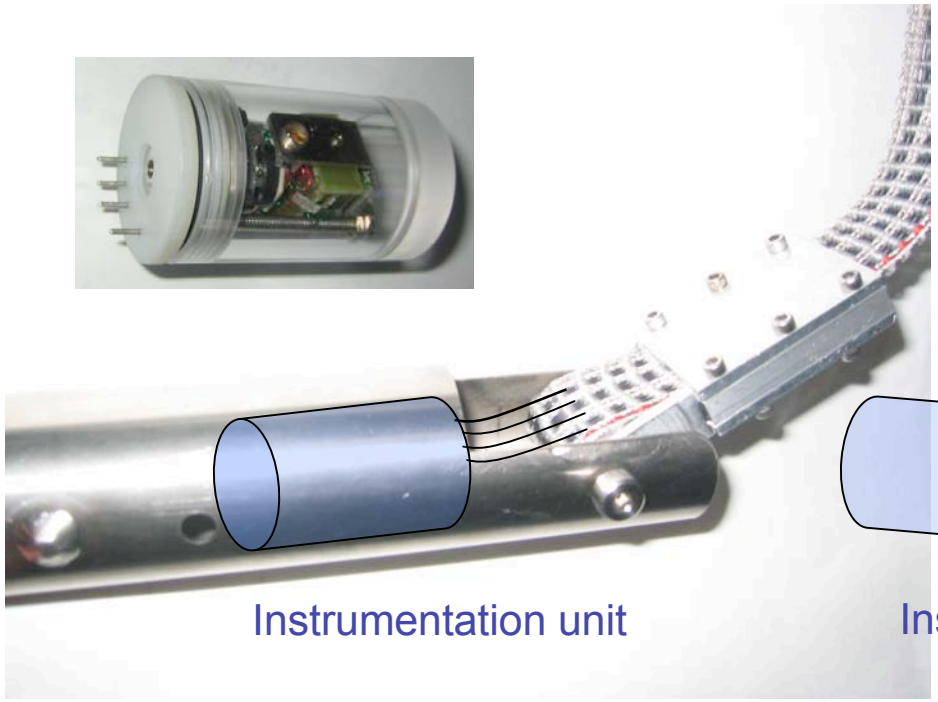




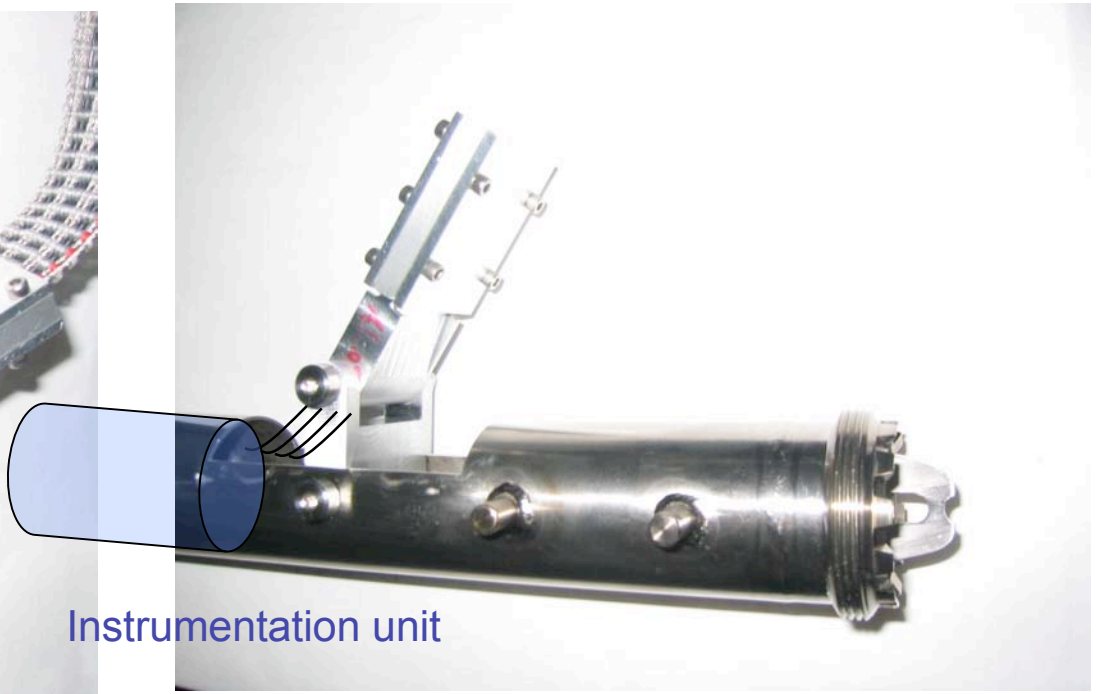
Thermometer	http://www.maxim-ic.com/quick_view2.cfm?qv_pk=2812&ln=
ADC	http://www.maxim-ic.com/quick_view2.cfm?qv_pk=2921&ln=
Interface	http://www.ibuttonlink.com/Link_Details.htm

Electrical Connections and Breakout at Cable Ends

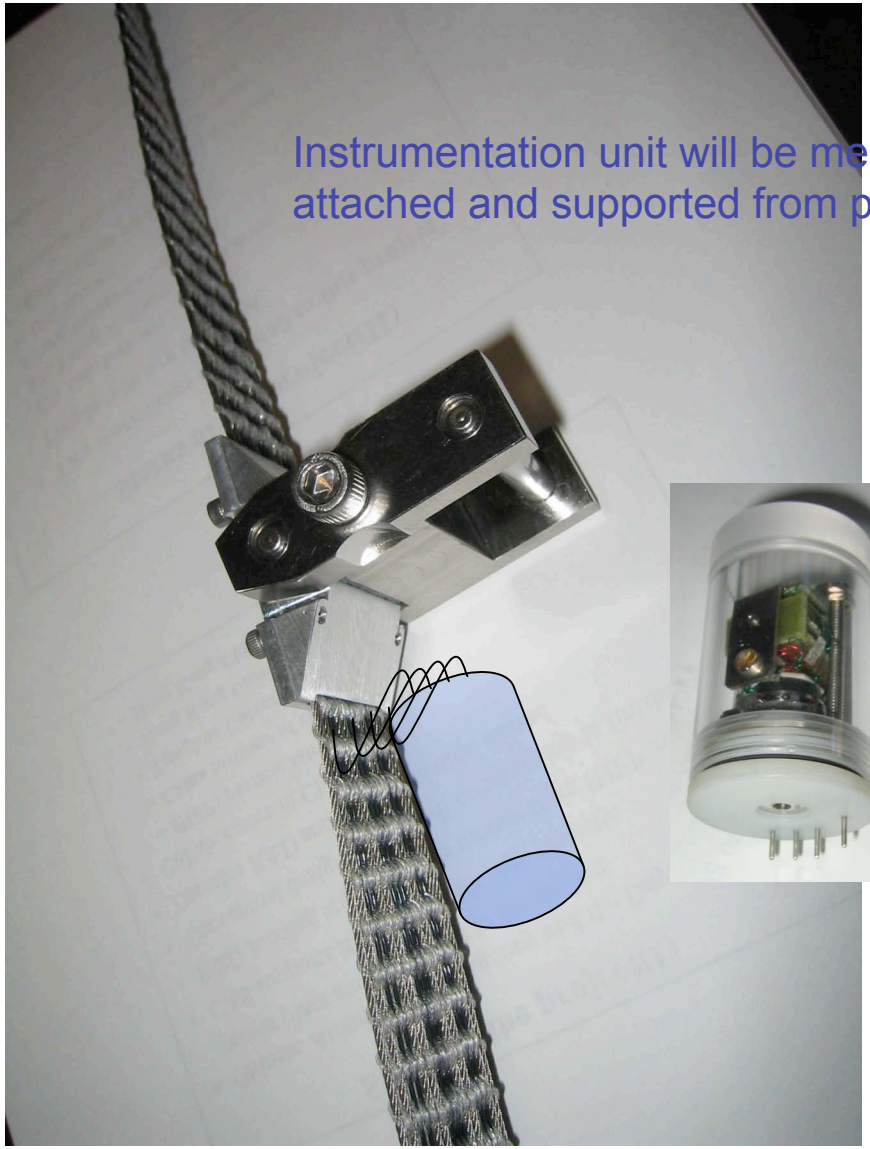
Top Cable End

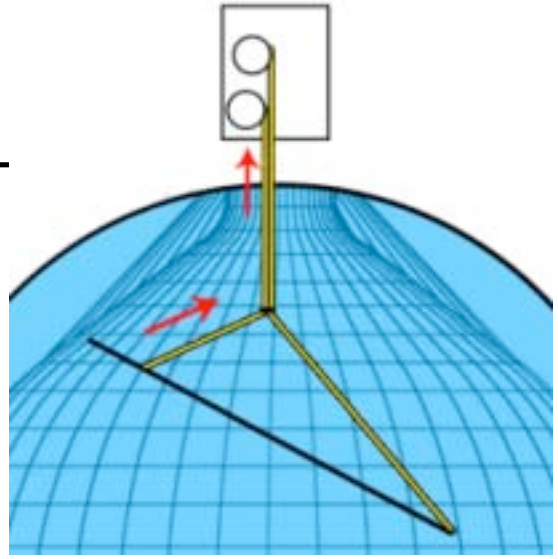


Lower Cable End



Electrical Connections at the Pivot Block





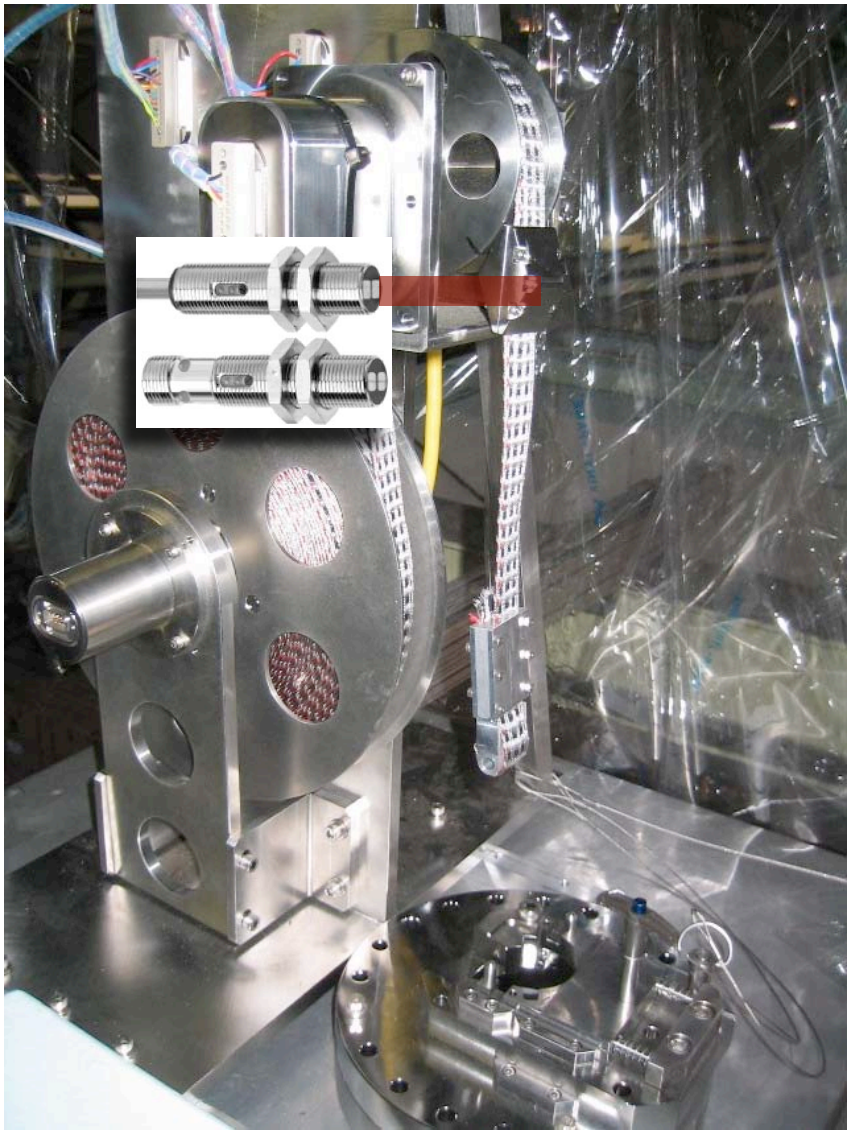
Planned Improvements and Remaining Technical Work

- Some Examples -

Photoelectric Relay - Home Position Sensor

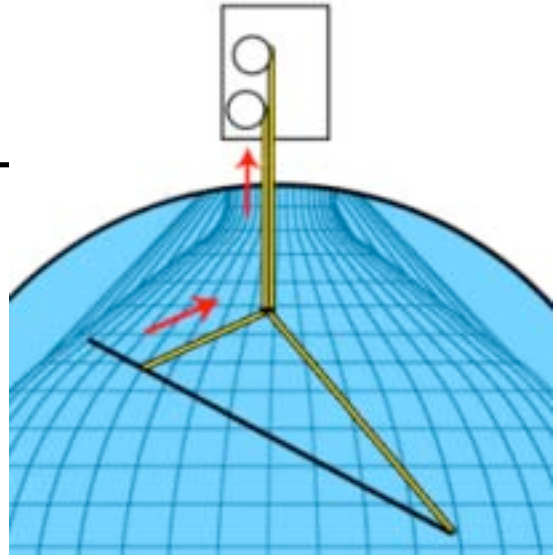
photoelectric IR sensor:

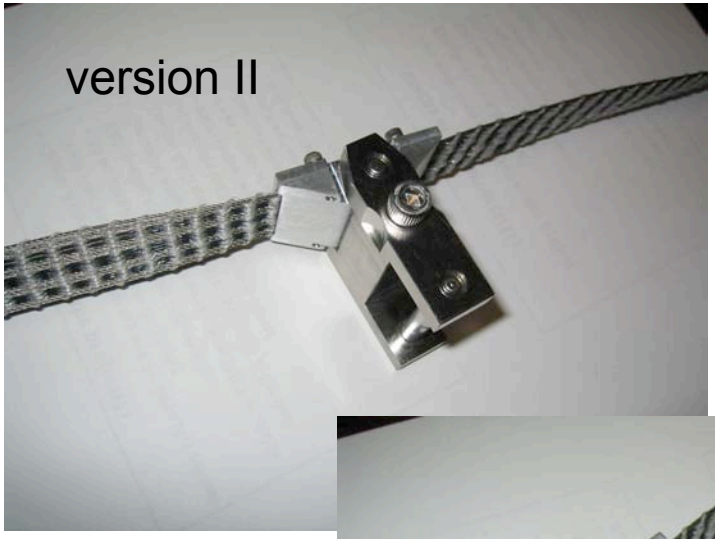
- stops system in home position
- calibrates position encoder



Pivot Block - Revisited

- consists of (1) pivot and (2) clamp
- uses cable clamp, no crimping
- adjustable positioning



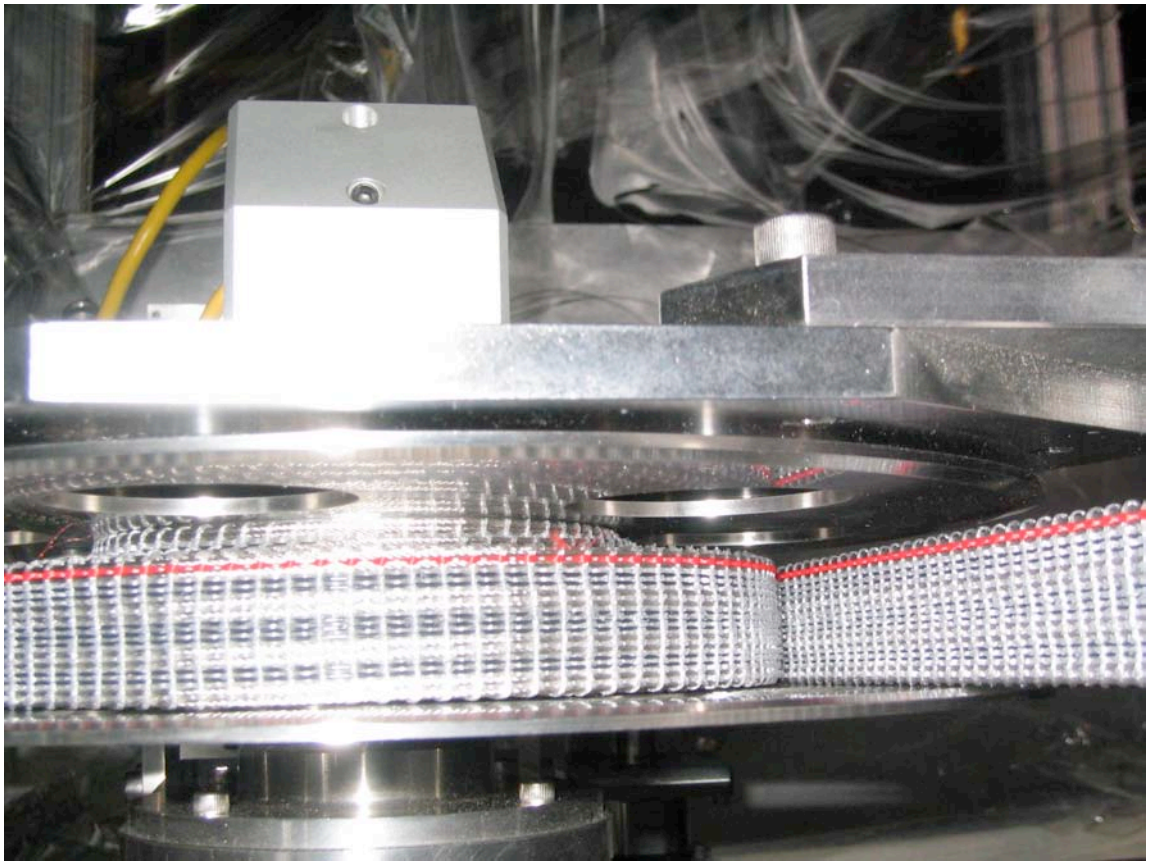


Spools

Needs:

- teflon or stainless spacers on both side of cable to fill spool gap and help guide cable

Quantity: 2 spools

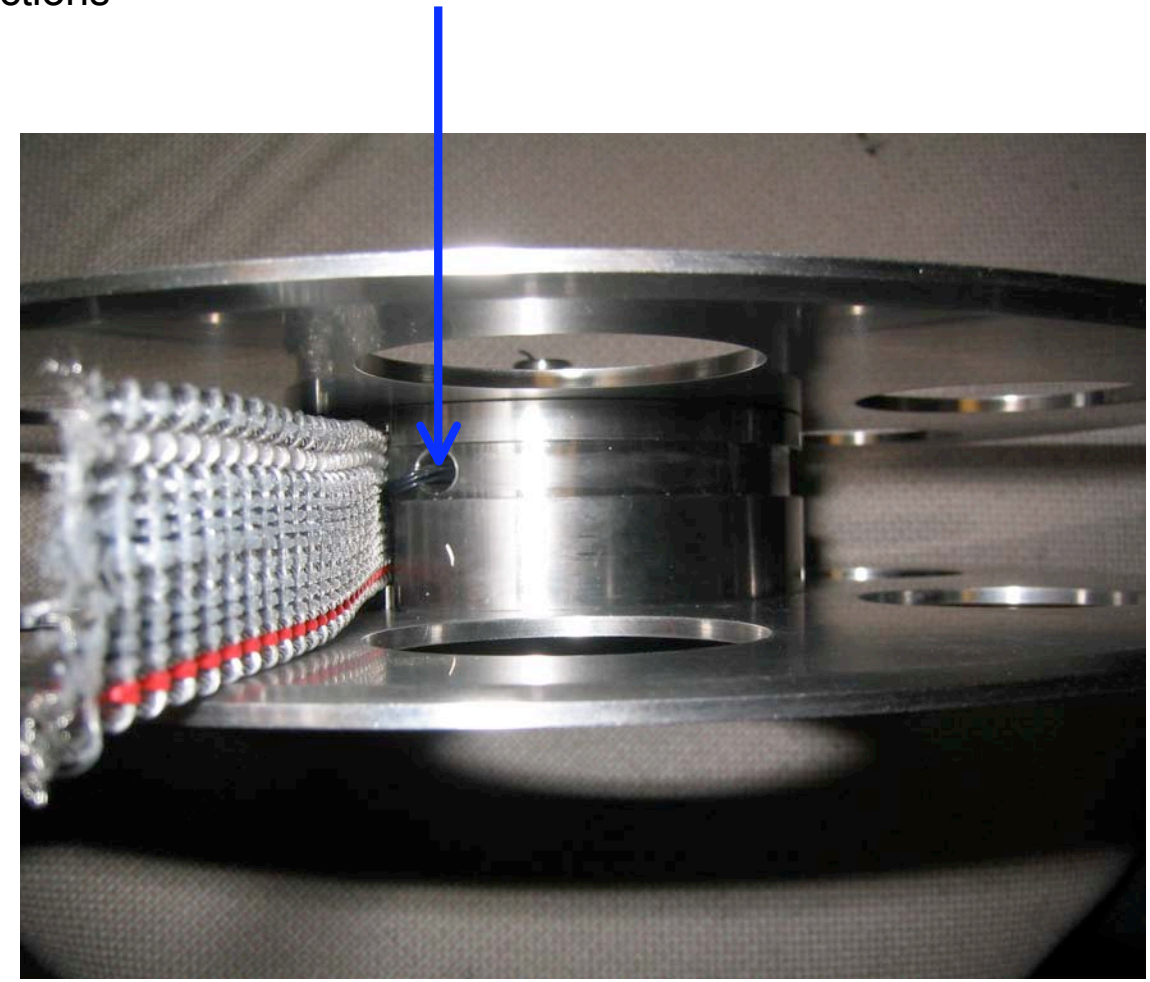


Spools

Needs:

- teflon seal plug for cable connections

Quantity: 2



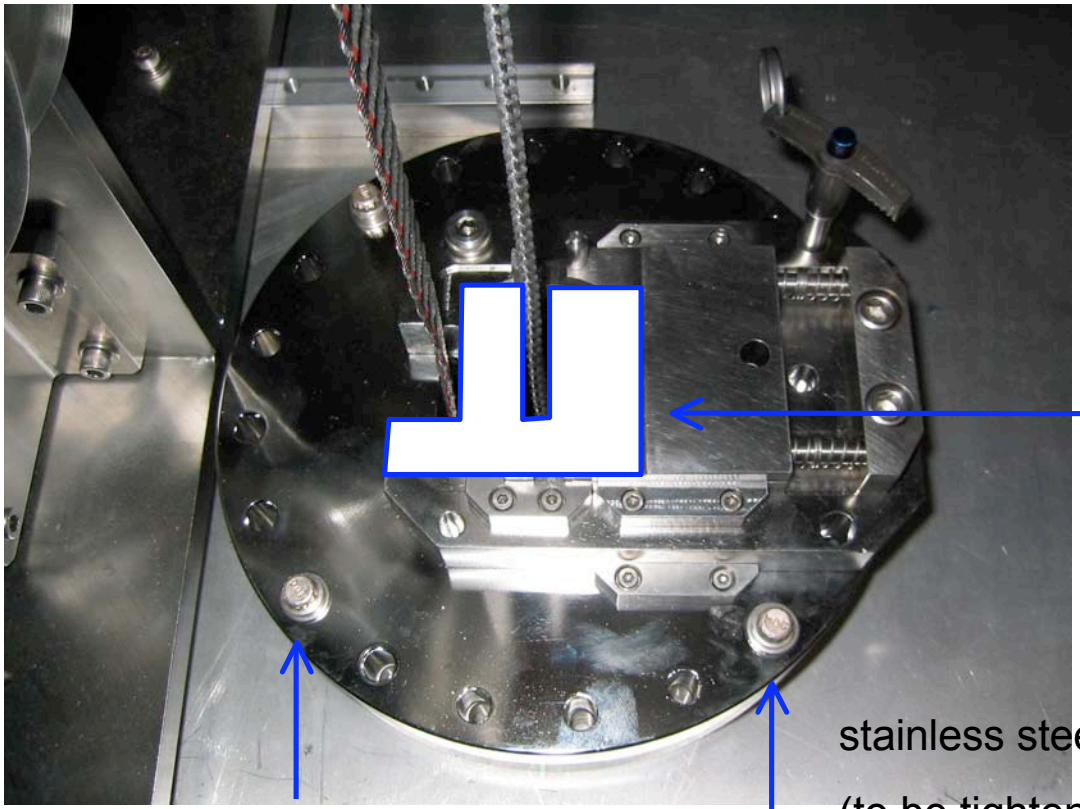
Pin Block

Needs:

- removable teflon cable guide

- stainless steel screws with “handle”

(to be tightened with gloves)

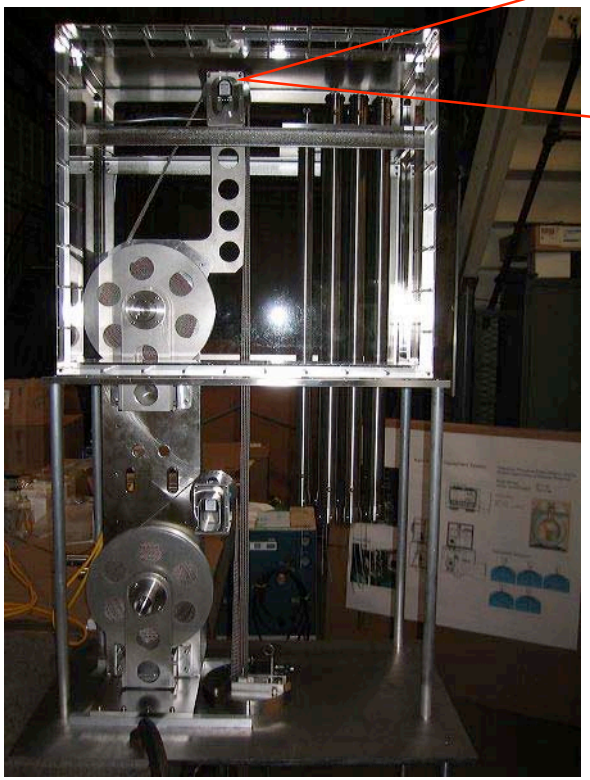


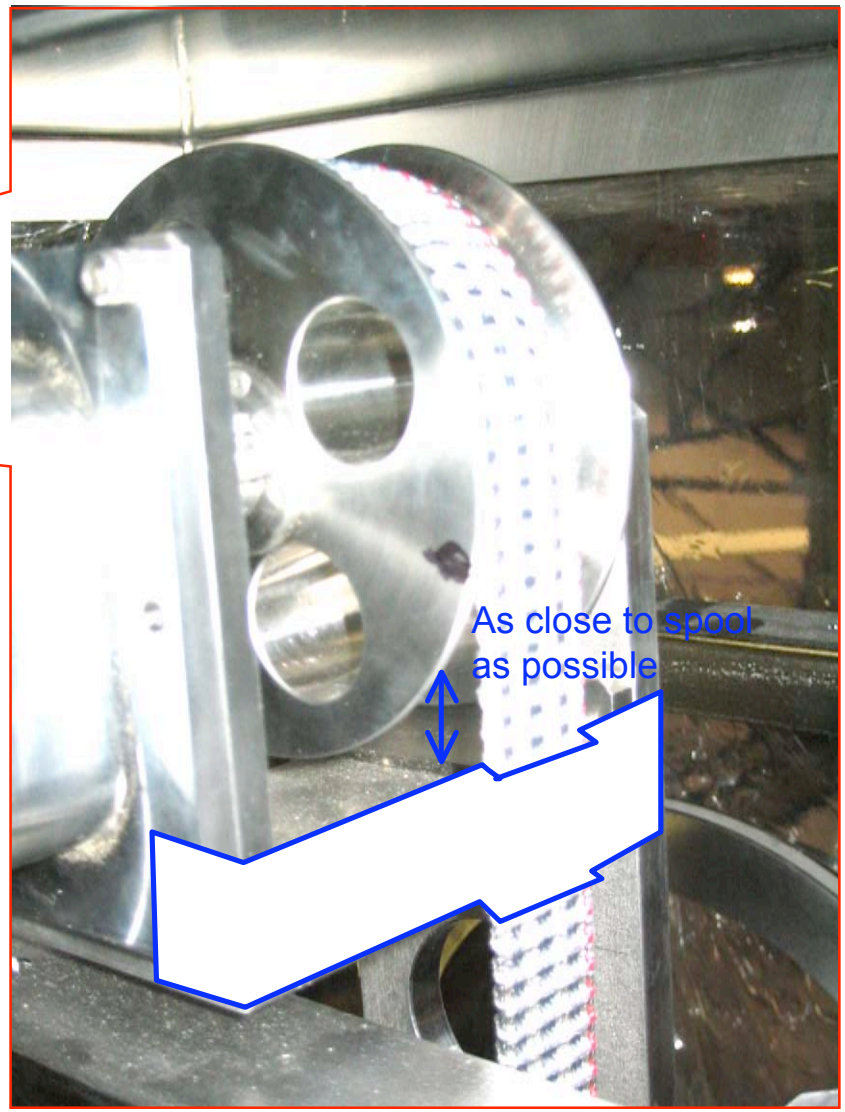
Encoder and Guide Pulleys

Upper Pulley

Needs:

- teflon cable guide for pulley



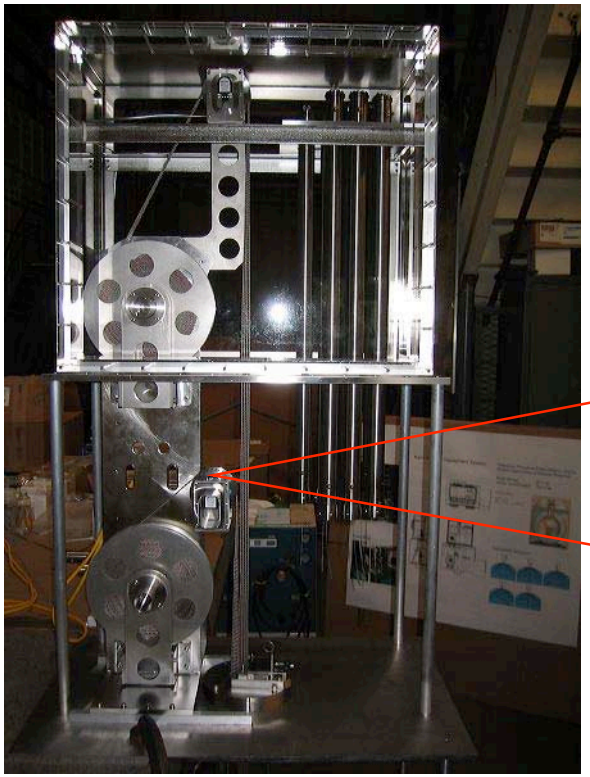


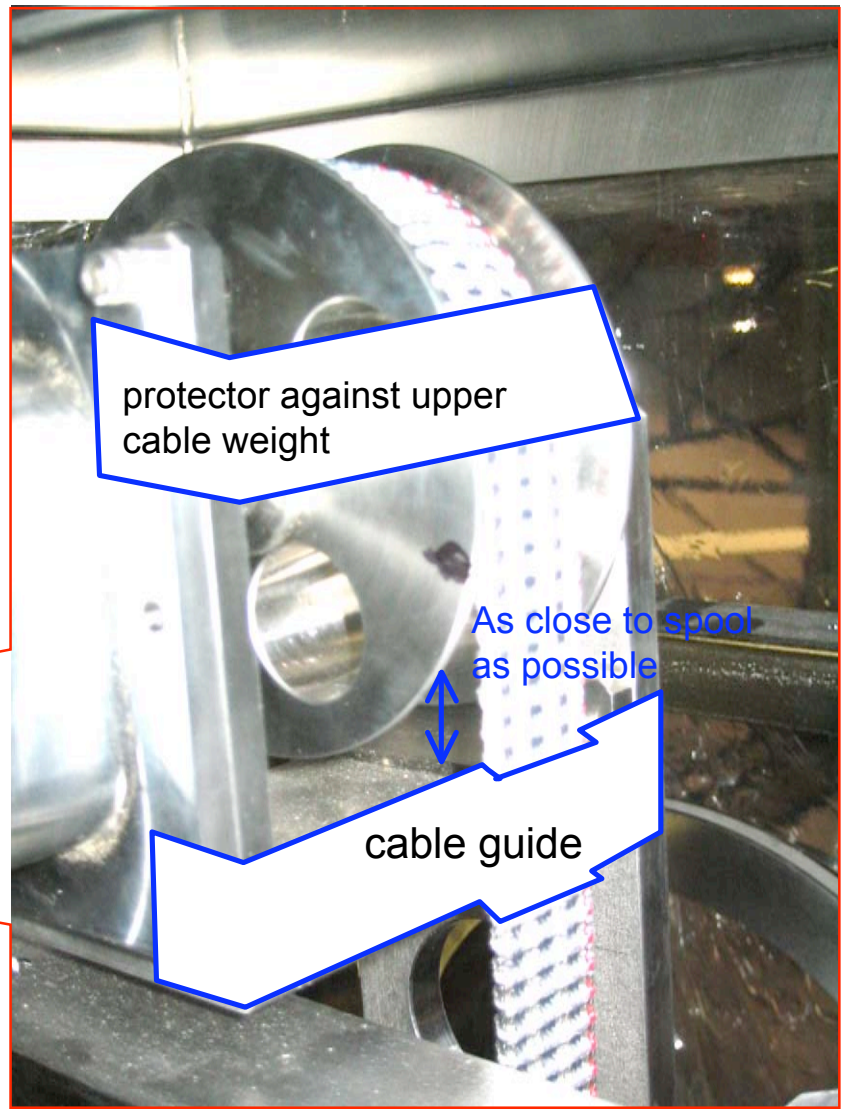
Encoder and Guide Pulleys

Lower Pulley

Needs:

- teflon protector against upper cable weight
- teflon cable guide for pulley



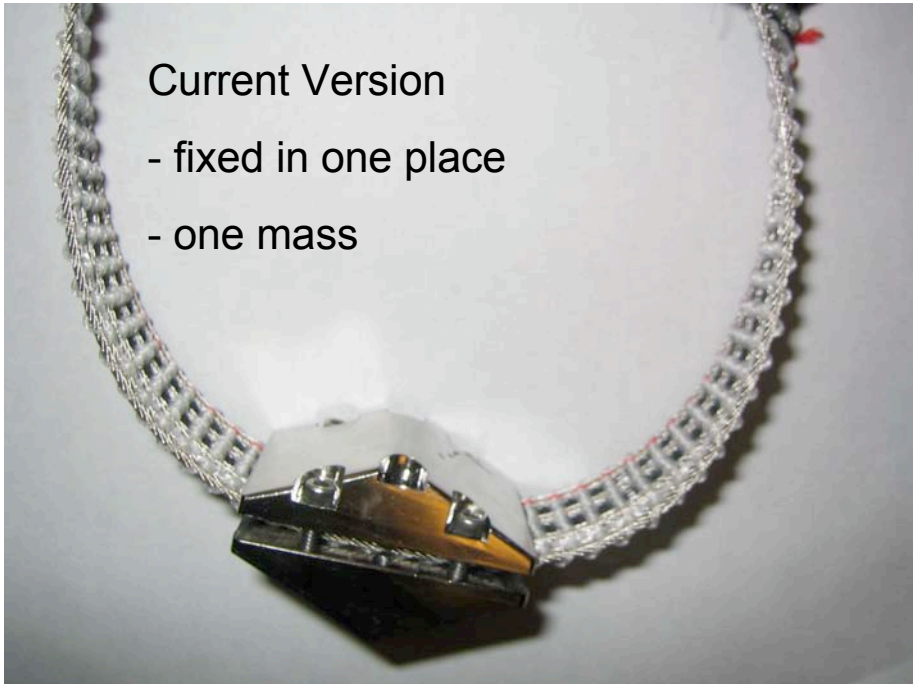


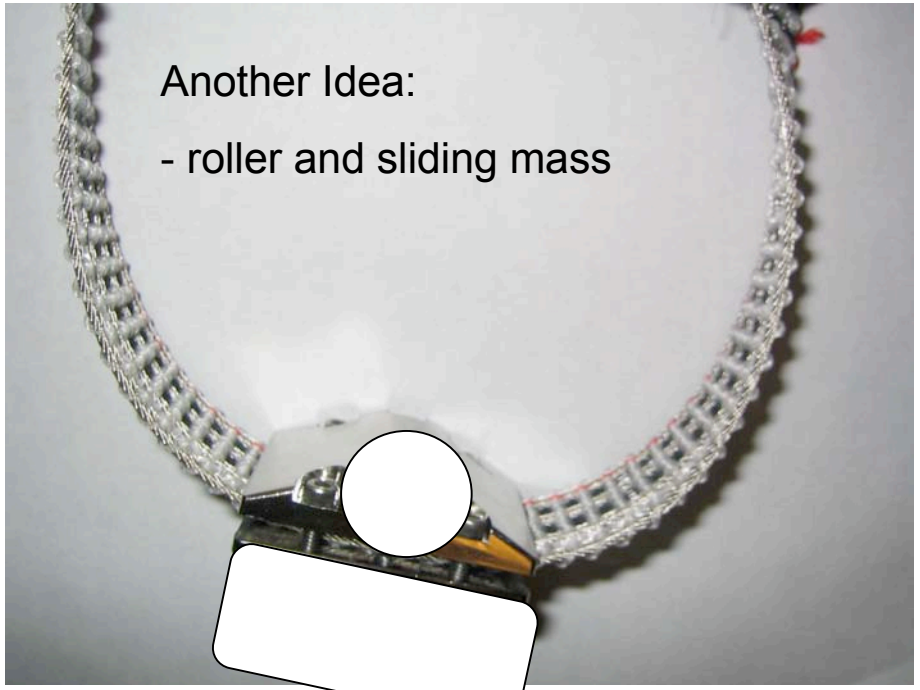
Cable Weight

Needs:

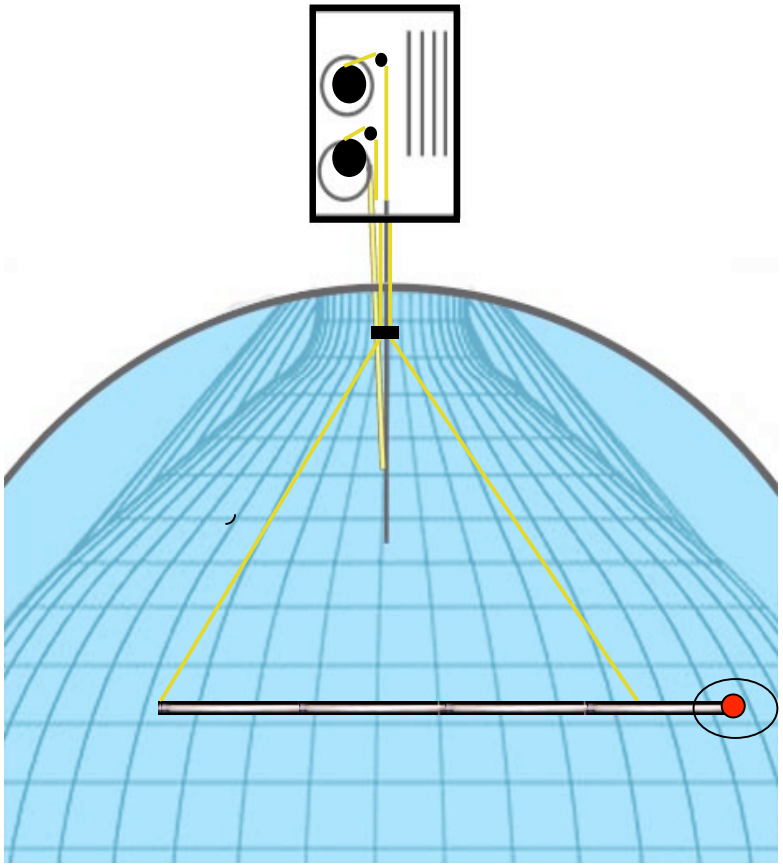
- sliding cable weight
- option to vary mass?

Quantity: 1





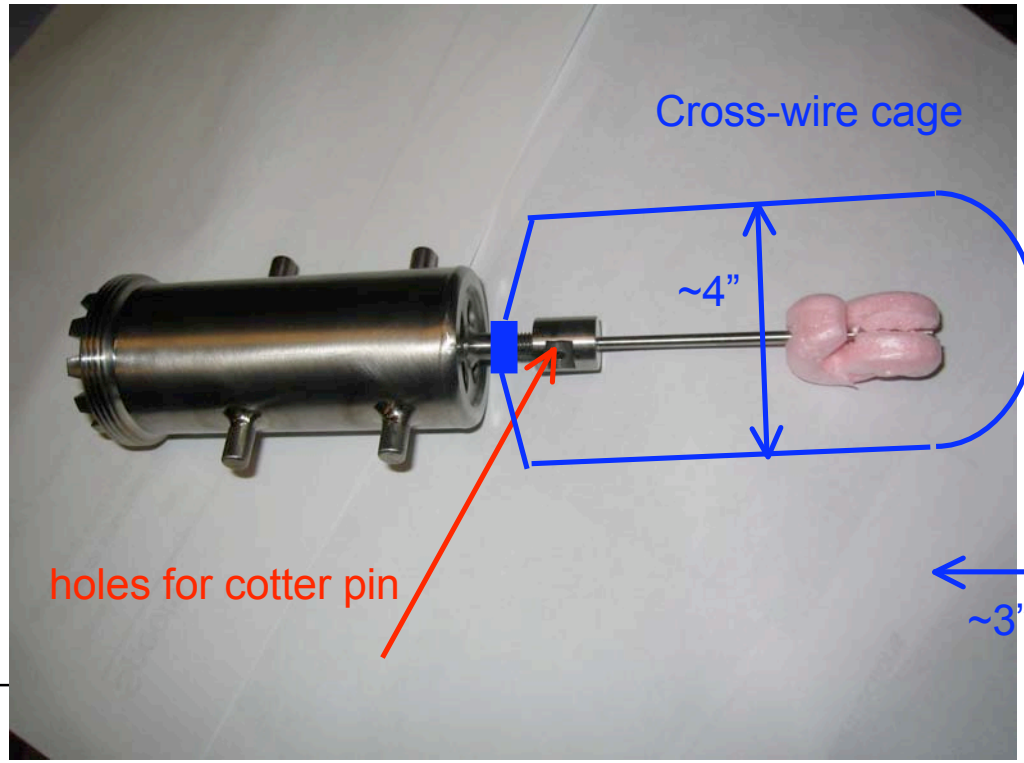
Source/Balloon Protection Cage



Needs:

- 2 stainless-steel cross wires as cage around source. wire cage attaches to source holder.

- make holes fit for cotter pin



Suggestions and Comments

Brian: • May not want to place 4pi control electronics in ehut, will cause noise.

→ Kengo, Karsten will look into placing controls on clean area. May need enclosure for control electronics rack. Also will need longer cables.

• What about slip clutch? Are we confident to use software interlock?

Marc: • Do we need drip pan in the glovebox?

Evgueni: • What about PPO residue when oil from cable evaporates in glovebox?

Chris: • Instead of slip clutch, can you integrate load sensor to create interlock for cable when it gets caught?

Marc/John: • Can you use exposed connectors for instrumentation unit in scintillator?

• What is conductivity of scintillator?